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NOAA Technical Report NMFS SSRF-692

Expendable Bathythermograph Observations from the NMFS/MARAD Ship of Opportunity Program for 1972

STEVEN K. COOK

SEATTLE, WA
June 1975

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SEATTLE, WA
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STEVEN K. COOK[1]

ABSTRACT

Results of the second year of operation of the NMFS/MARAD Ship of Opportunity Program are presented in the form of vertical distributions of temperature and horizontal distributions of sea surface salinity and temperature. Operational and data management procedures also are discussed.

INTRODUCTION

In midyear of 1970 a cooperative expendable bathythermograph (XBT) program was initiated between the National Marine Fisheries Service (NMFS) and the Maritime Administration (MARAD) of the U.S. Department of Commerce. The program, conducted in support of the Marine Resources Monitoring Assessment and Prediction Program of NMFS, involved the use of Maritime Cadets from the Kings Point Maritime Academy to gather XBT data on board various merchant ships along the east and Gulf coasts of the United States. The objective of this cooperative program was to identify and describe seasonal and year-to-year variations of temperature and circulation in major currents of the tropical Atlantic, Caribbean Sea, Gulf of Mexico, and western North Atlantic, utilizing merchant ships as relatively inexpensive platforms for the collection of data.

The processed data were used to construct vertical sections of temperature and horizontal plots of sea surface temperature and salinity. The final form of the vertical and horizontal sections (Figs. 1-81) are printed in this report.

Approximately 75 more XBT drops and associated surface data were collected but are not represented in this report because the observations were much too scattered in time and space to be formed into transects. All data collected, whether represented in this report or not, were archived by the National Oceanographic Data Center (NODC) and are available to interested persons through the NODC, Washington, D.C. 20235.

Further details concerning the acquisition or processing of data from the cruises considered here can be obtained from the author.

AREAS OF STUDY

Ship routes were selected to obtain regular sampling in the most dynamic areas of the Gulf of Mexico, Caribbean Sea, and western tropical Atlantic Ocean; namely, the Yucatan Channel, Straits of Florida, and the Antilles, Equatorial, and Guiana currents. Repeated coverage is important for comparative analysis, so ships with the most regular schedules were chosen.

DATA ACQUISITION AND PROCESSING

Subsurface temperature data were obtained by use of Sippican XBT systems. At the same time surface water samples were collected with bucket thermometer units for later analysis to determine salinity. This procedure also provided a surface reference temperature necessary for the calculation of surface density or sigma-*t*. The surface water samples were analyzed on shore using a Beckman inductive salinometer calibrated with standard (Copenhagen) water at least once per 30 samples.

The XBT traces from approximately the first half of the year were digitized, key punched, and quality controlled by NMFS personnel. Those from the balance of the year were digitized and key punched by NODC personnel. The data from both halves of the year were then submitted to NODC for further processing and listing.

DISCUSSION

This second year of operation of the NMFS/MARAD Ship of Opportunity Program was highlighted by two events. The first was the commencement of involvement of NODC in the processing of the Ship of Opportunity data. Programs are being developed at NODC to process these data from the analog traces to computer plots within a 10- to 14-day turnaround time. While this program is not completely operational at this writing, it is expected to be in time for the 1973 report.

The second event was the increase in data collected by the MARAD cadets. The utilization of two more ships, one out of New York and one out of New Orleans, allowed for a 25% increase in data collected over 1971. The addition of two ships yielded a total of six (three out of New York and three out of New Orleans) involved with the program.

Future program improvements should take the form of more intense coverage over a smaller geographical area. Discussions held in late 1972 led to a decision to reduce the area to be covered and increase the density of XBT drops in 1973. This should yield data more useful for fisheries research.

ACKNOWLEDGMENTS

Appreciation is extended to the Maritime Academy Training Representatives in New York and New Orleans, M.

[1] Atlantic Environmental Group, National Marine Fisheries Service, NOAA, R.R. 7A, Box 522-A, Narragansett, RI 02882.

Chicurel and D. Thompson, for their diligent efforts to place cadets on board ships that were scheduled to traverse preselected oceanic areas. In addition, thanks are extended to the Moore McCormack Lines and Grace Prudential Lines of New York and the Delta Steamship Company and Lykes Brothers Lines of New Orleans whose full and courteous cooperation was essential for the success of this program.

FIGURES

The figures are grouped by geographical location and time. They consist of two horizontal maps and one vertical section for each transect of each ship. The two horizontal maps include station location with sea surface temperature in °C, and station location with sea surface salinity in ‰. The vertical cross section consists of temperature at whole degree isotherms in °C and depth in meters.

GULF OF MEXICO AND CARIBBEAN TRANSECTS

Figures	Vessels	Date (1972)
1-3	*Gulf Shipper*	25-28 Feb.
4-6	*Gulf Shipper*	26-28 Mar.
7-9	*Gulf Shipper*	30 Apr.-4 May
10-12	*Gulf Shipper*	6- 7 June
13-15	*Gulf Shipper*	21-28 Aug.
16-18	*Delta Argentina*	14-18 Nov.

WESTERN ATLANTIC AND EASTERN CARIBBEAN TRANSECTS

19-21	*Mormac Trade*	27 Jan.-1 Feb.
22-24	*Bay State*	10-14 Feb.
25-27	*Bay State*	19-23 Feb.
28-29	*Santa Cruz*	13-25 Mar.
30-31	*Santa Cruz*	26-29 Mar.
32-33	*Delta Brazil*	1- 3 Apr.
34-35	*Mormac Cape*	9-17 Apr.
36-37	*Santa Cruz*	4- 8 Apr.
38-39	*Santa Cruz*	1- 5 May
40-41	*Mormac Cape*	20-25 May
42-44	*Santa Cruz*	29 May-8 June
45-47	*Santa Cruz*	8-18 June
48-50	*Santa Cruz*	28 June-14 July
51-52	*Santa Cruz*	15-18 July
53-55	*Santa Cruz*	25-31 July
56-58	*Santa Cruz*	11-14 Aug.
59-61	*Santa Cruz*	21 Aug.-1 Sept.
62-64	*Santa Cruz*	2-13 Sept.
65-67	*Santa Cruz*	17-30 Sept.
68-70	*Santa Cruz*	30 Sept.-9 Oct.
71-73	*Mormac Pride*	4-13 Oct.
74-78	*Santa Cruz*	15-18 Oct.
79-81	*Santa Cruz*	3- 5 Nov.

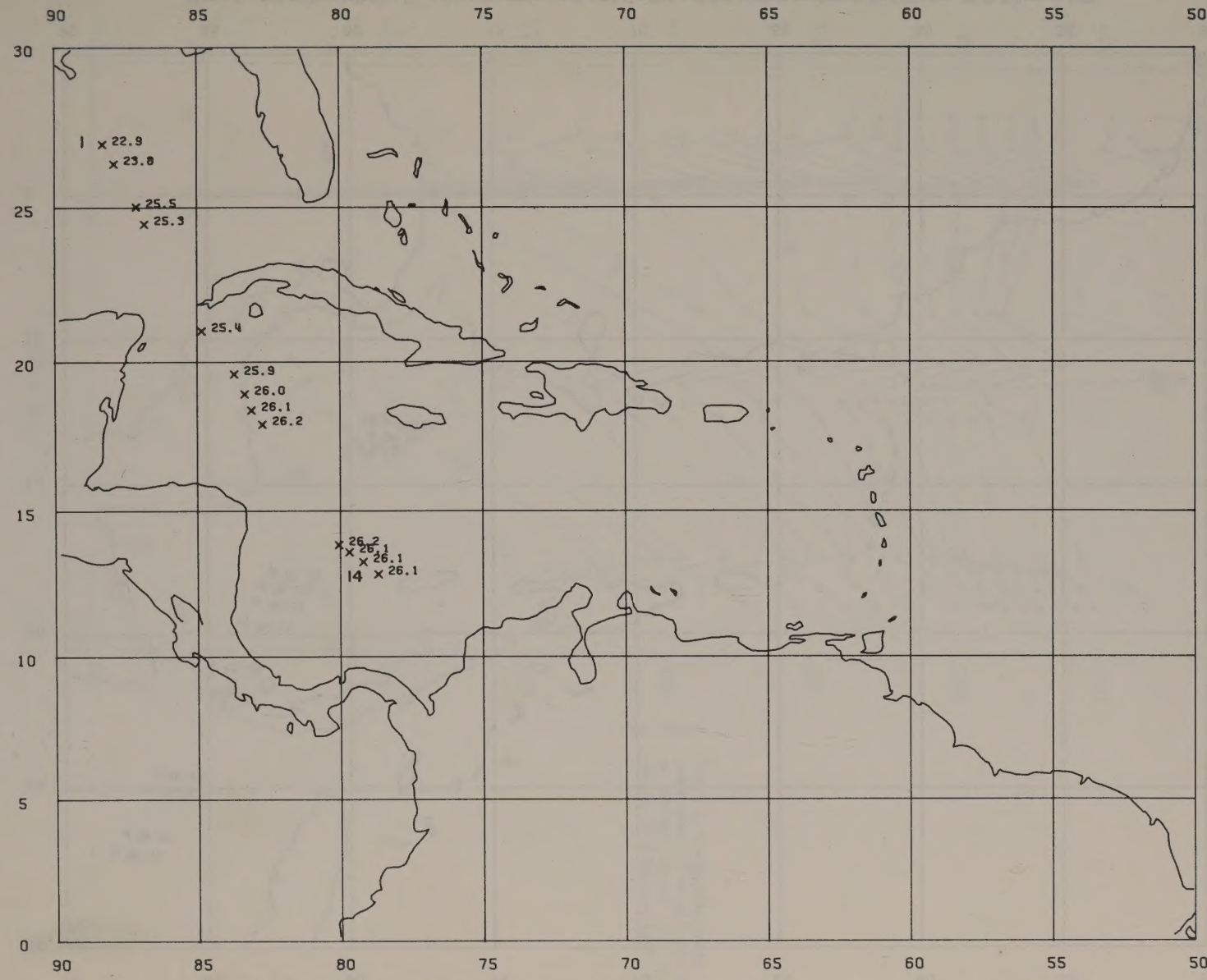


Figure 1.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Gulf Shipper*, **25-28 February 1972.**

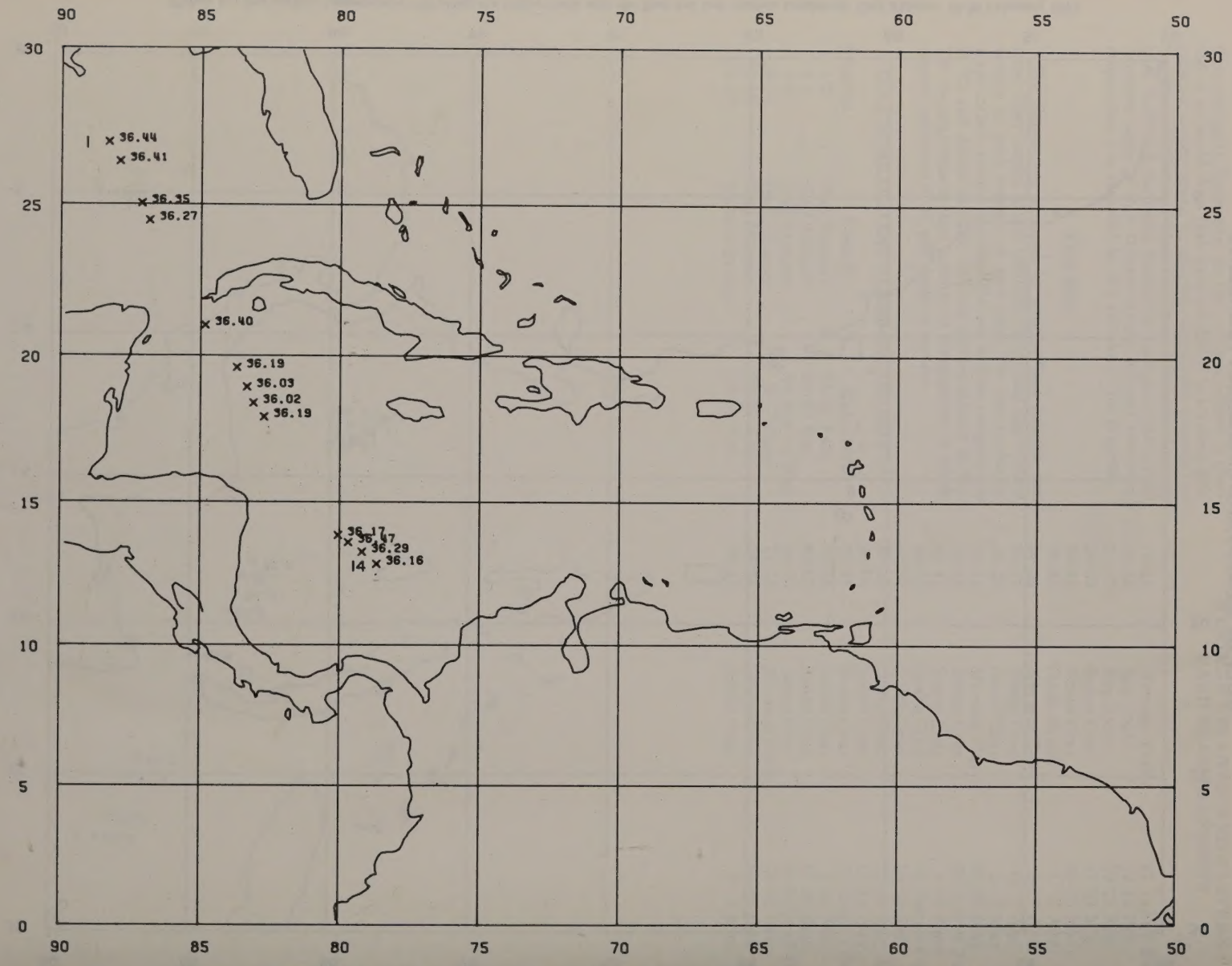


Figure 2.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Gulf Shipper*, **25-28 February 1972.**

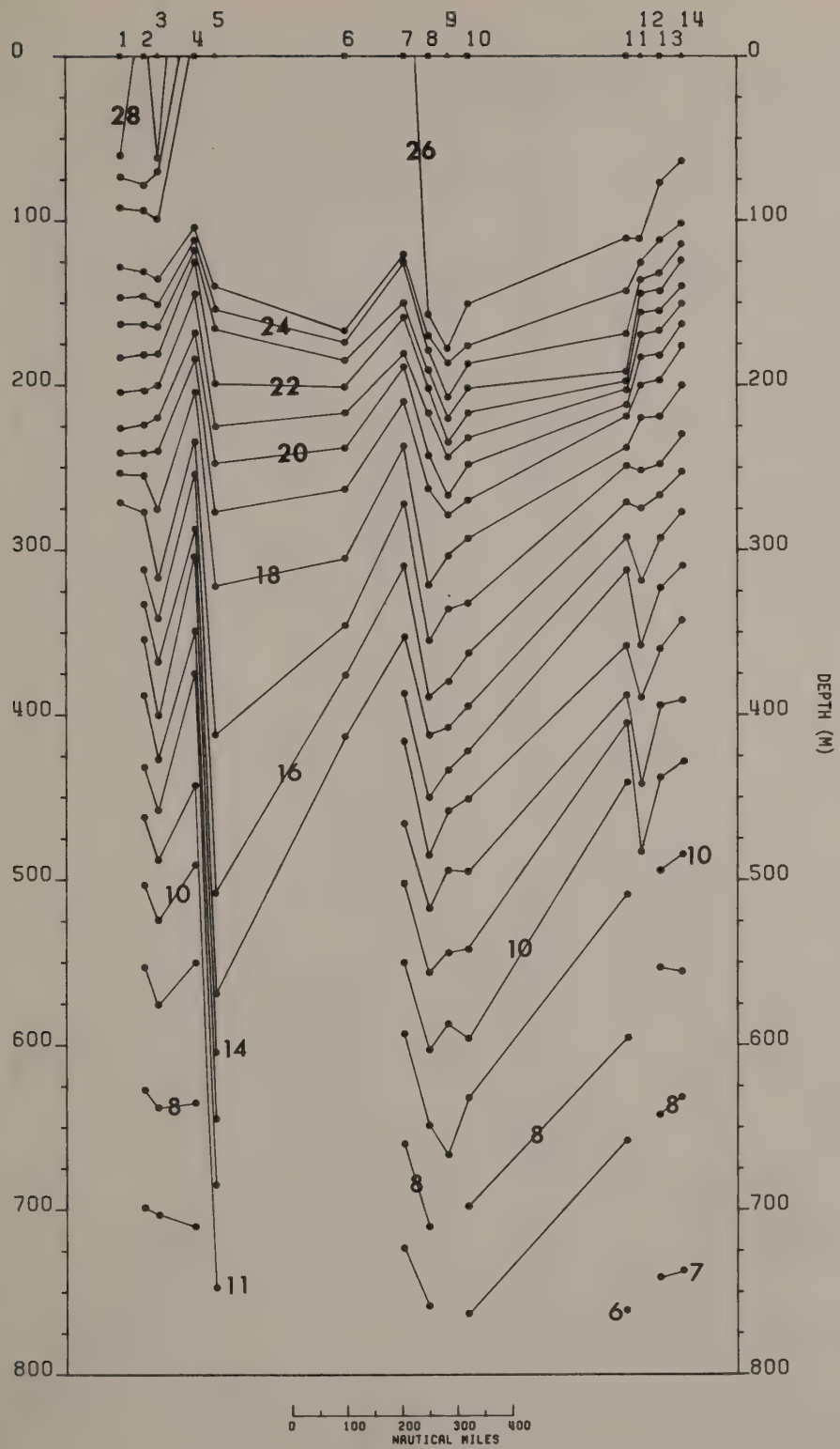


Figure 3.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Gulf Shipper*, 25-28 February 1972.

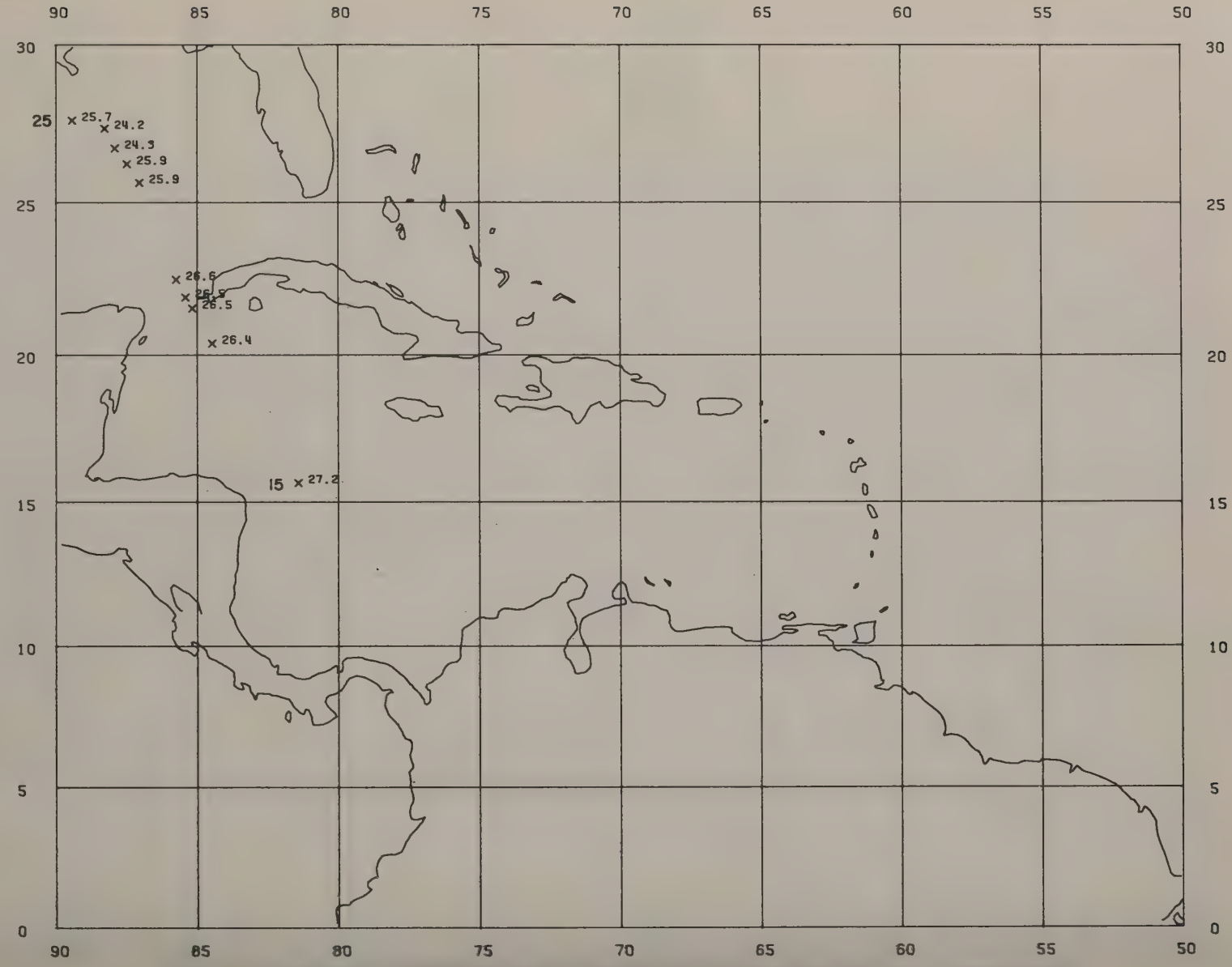


Figure 4.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Gulf Shipper*, **26-28 March 1972.**

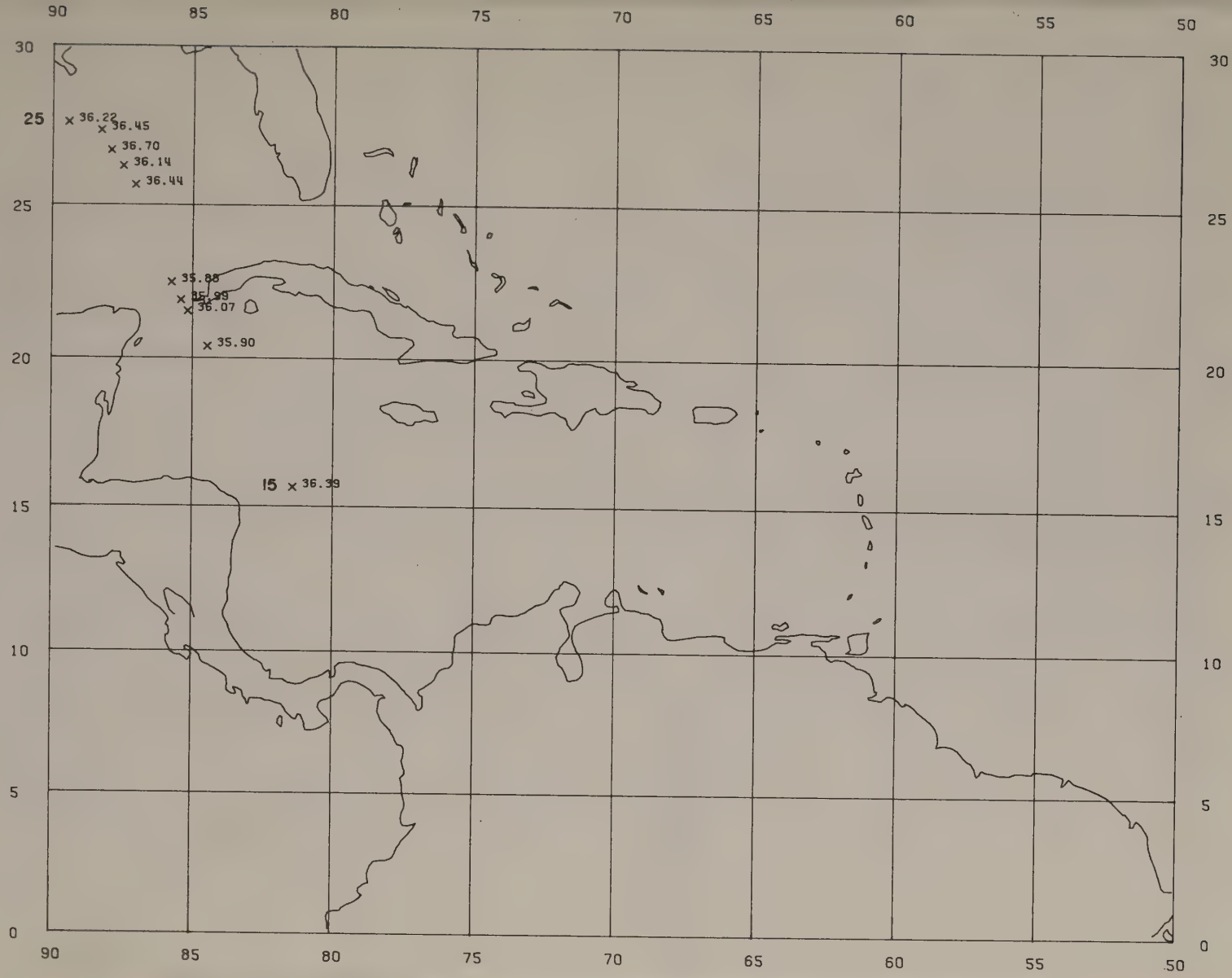


Figure 5.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Gulf Shipper*, **26-28 March 1972.**

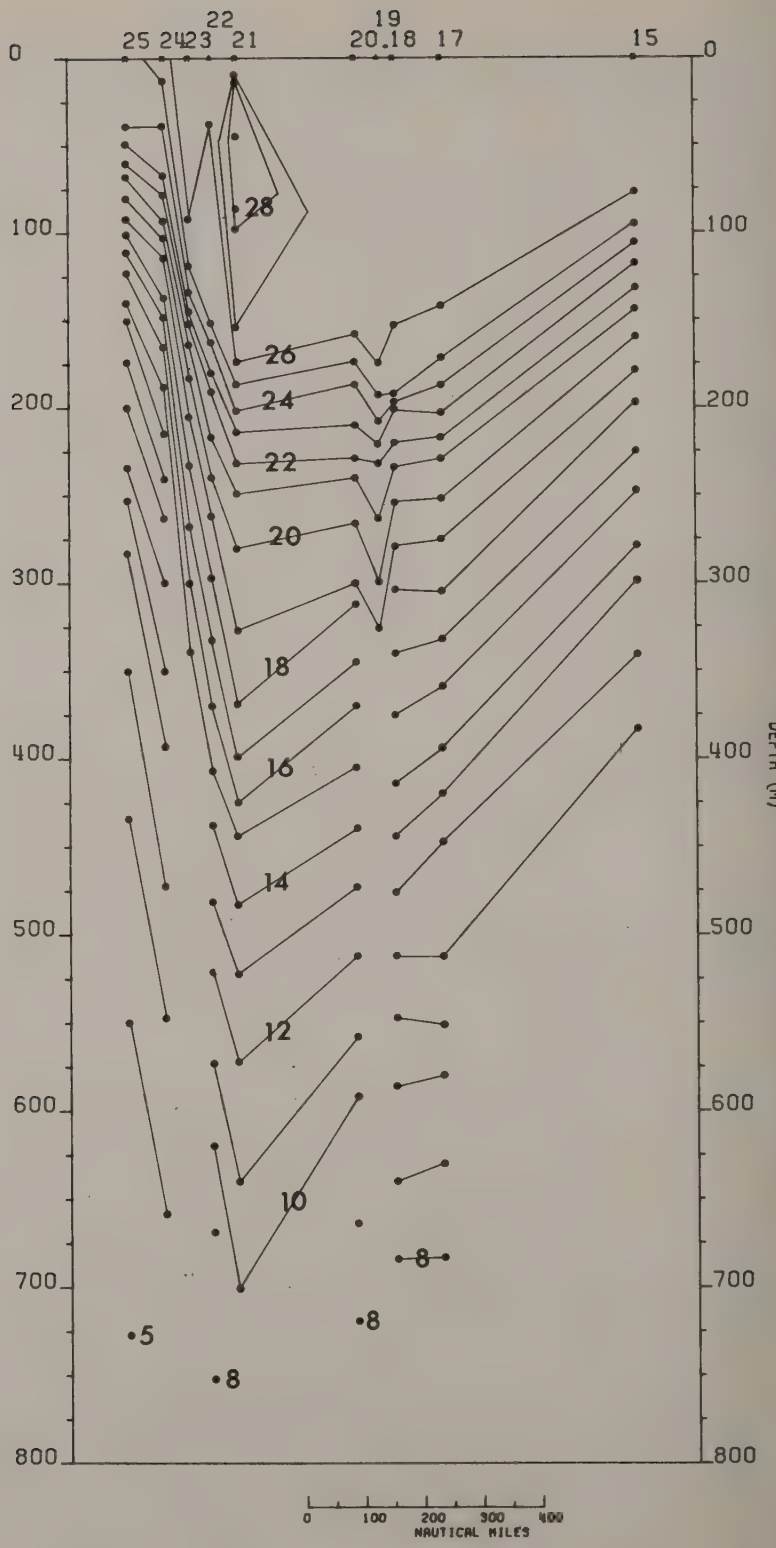


Figure 6.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Gulf Shipper*, 26-28 March 1972.

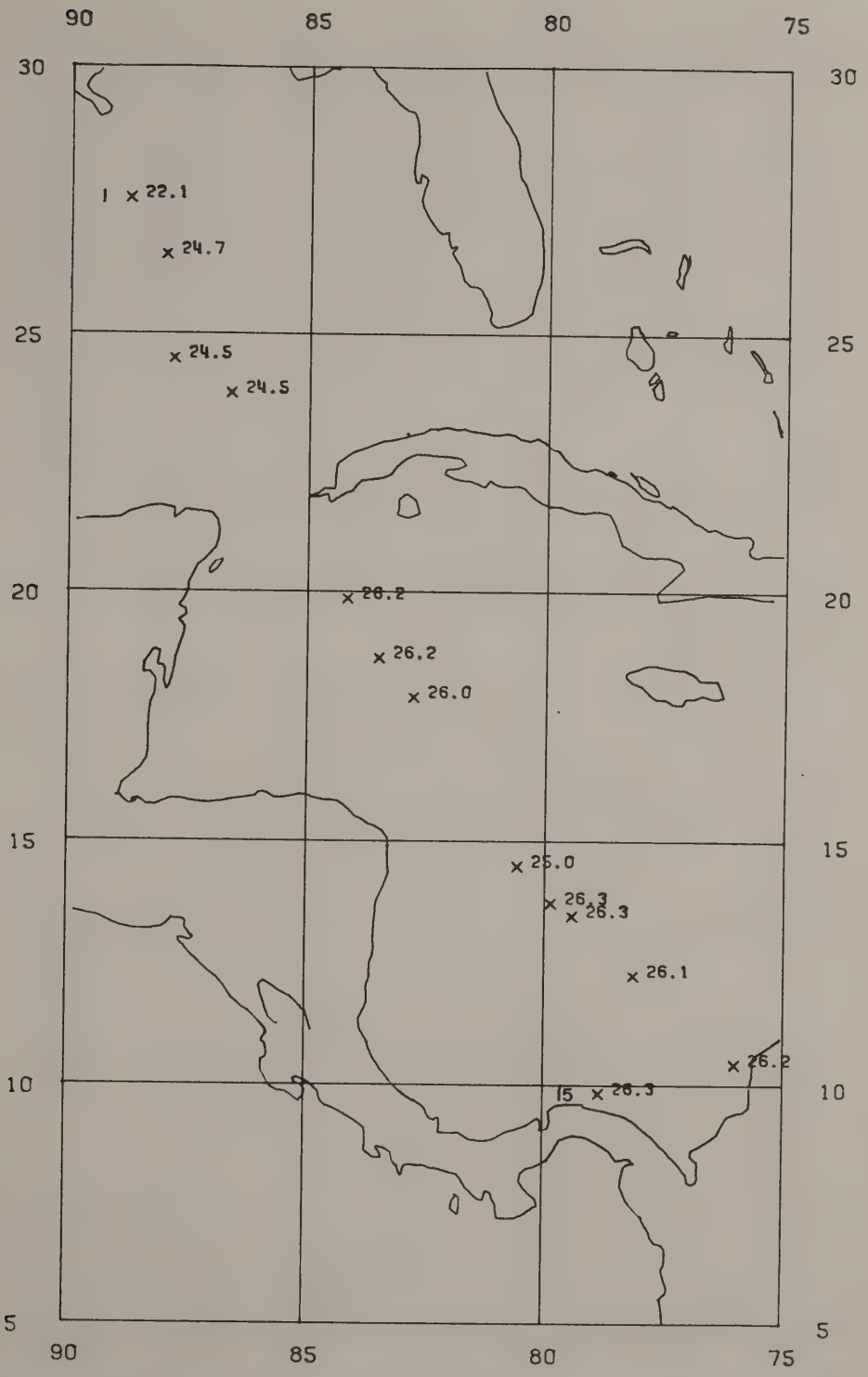


Figure 7.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Gulf Shipper*, **30 April-4 May 1972.**

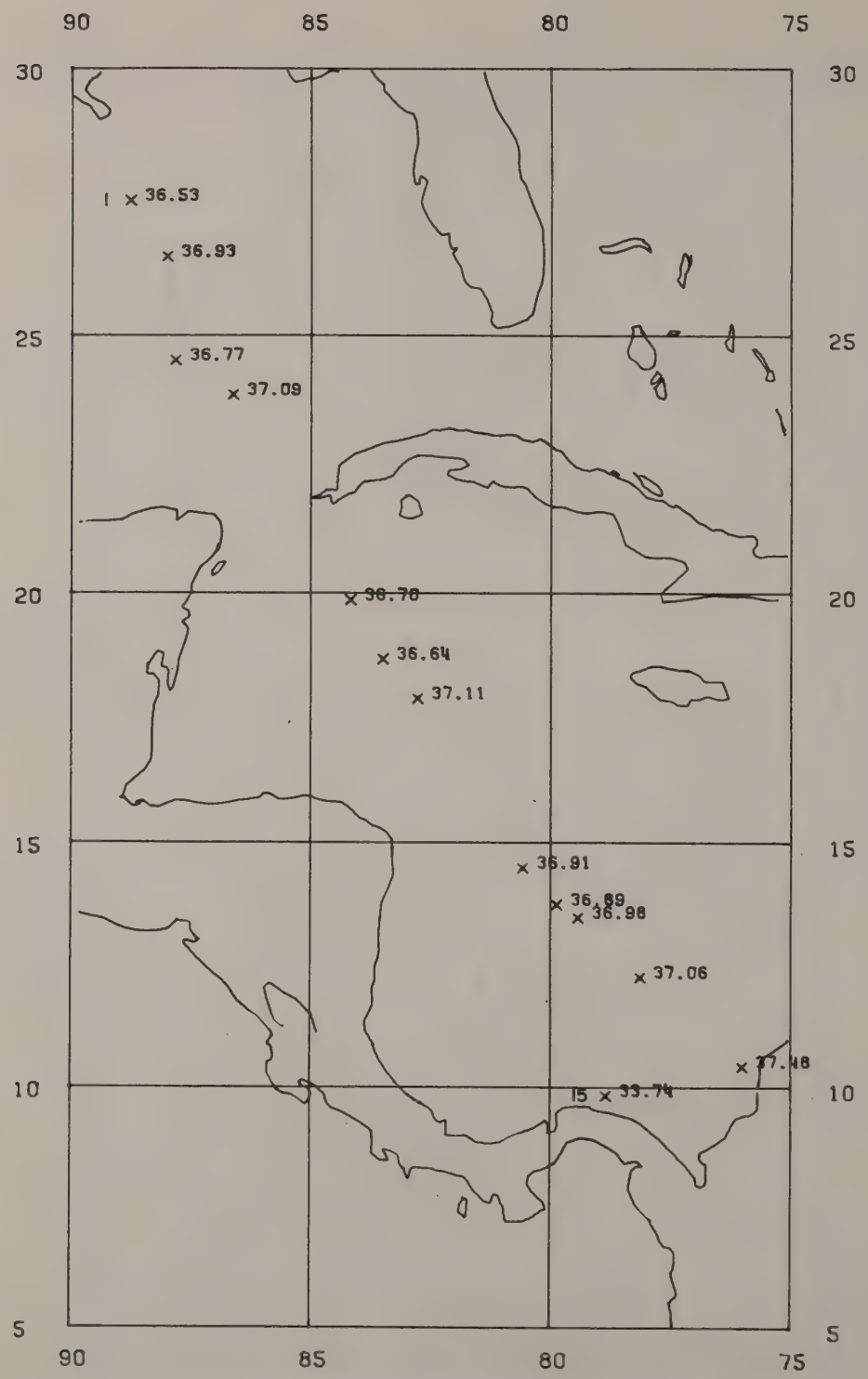


Figure 8.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Gulf Shipper*, **30 April-4 May 1972.**

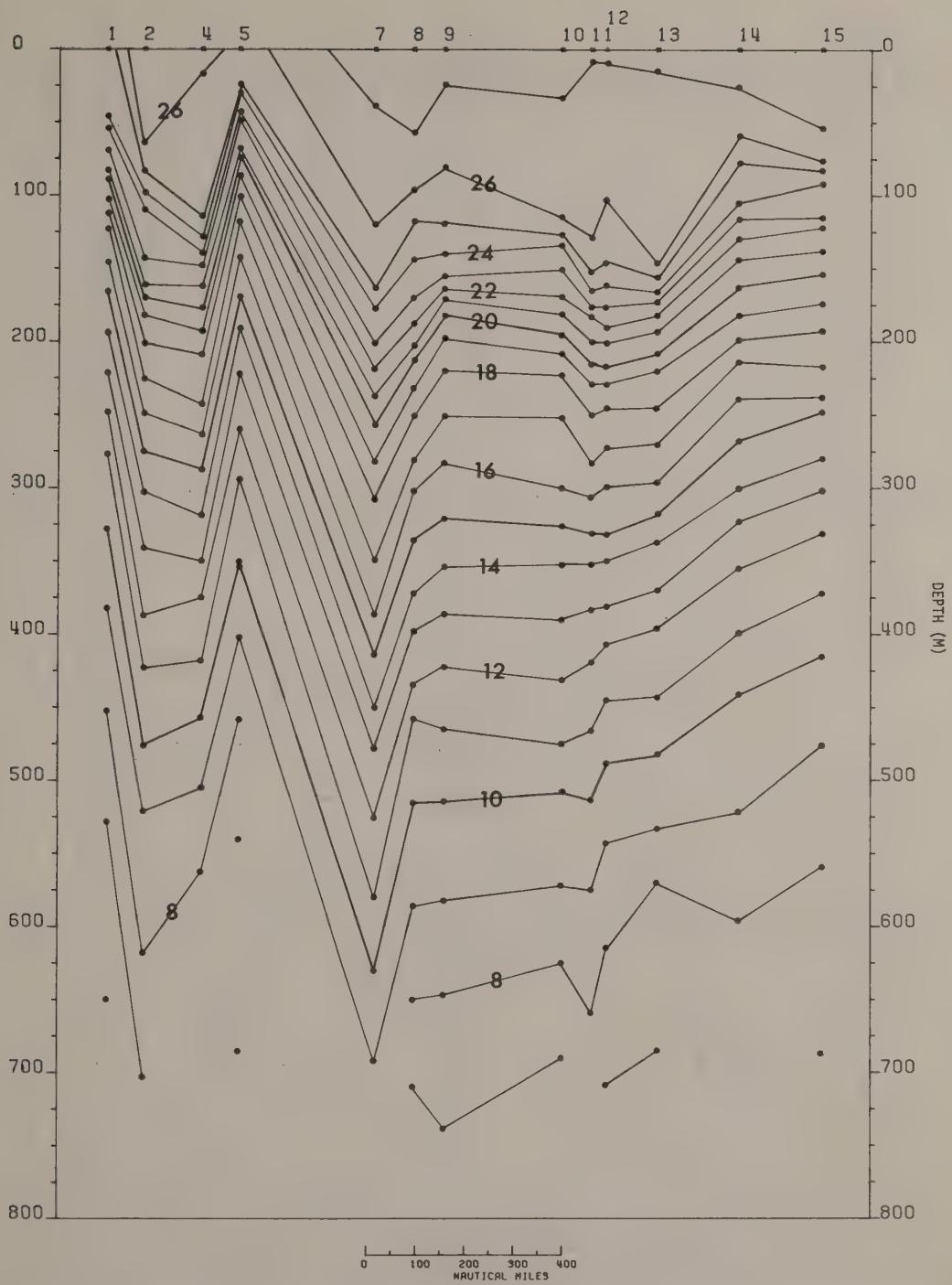


Figure 9.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Gulf Shipper*, **30 April-4 May 1972.**

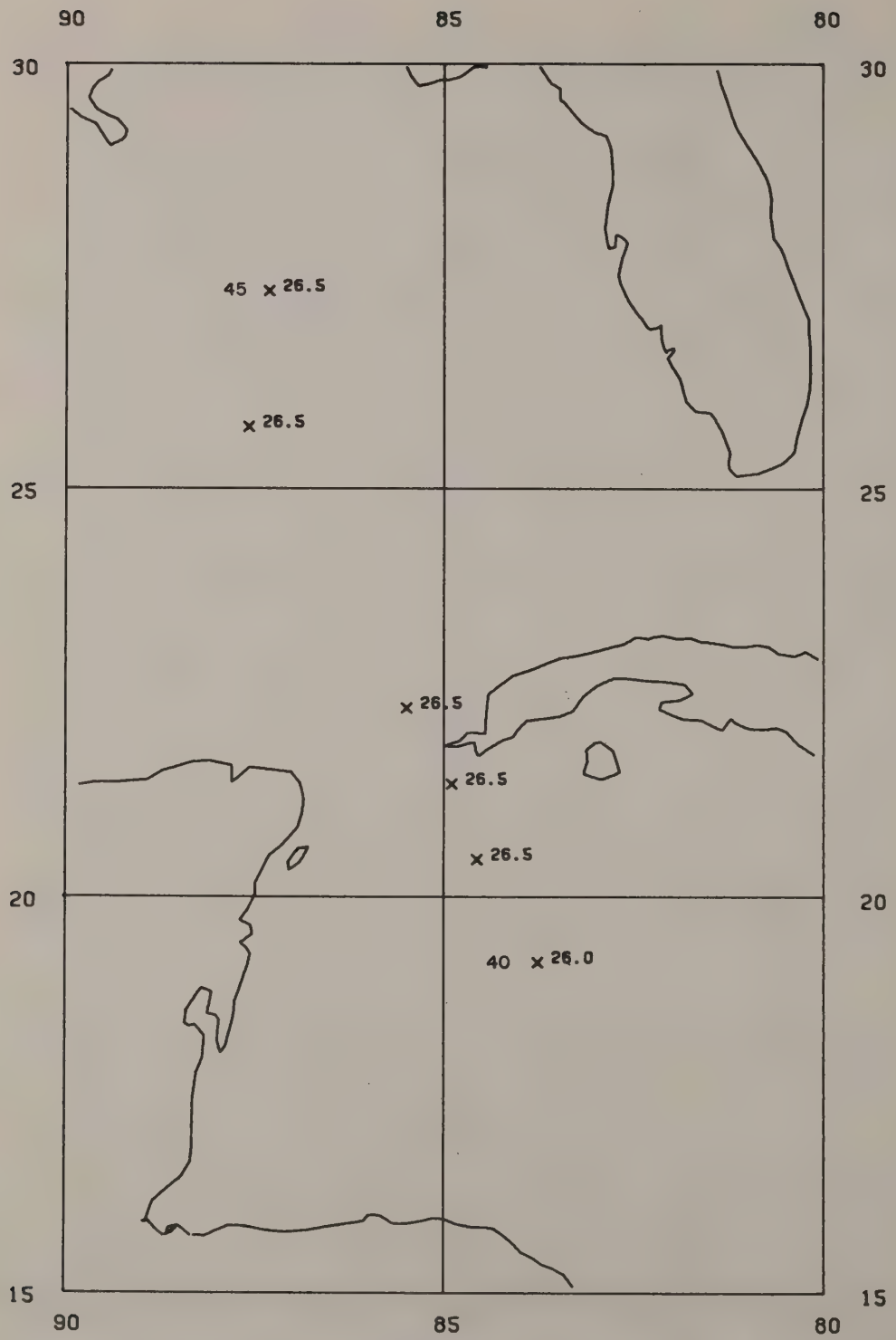


Figure 10.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Gulf Shipper*, 6-7 June 1972.

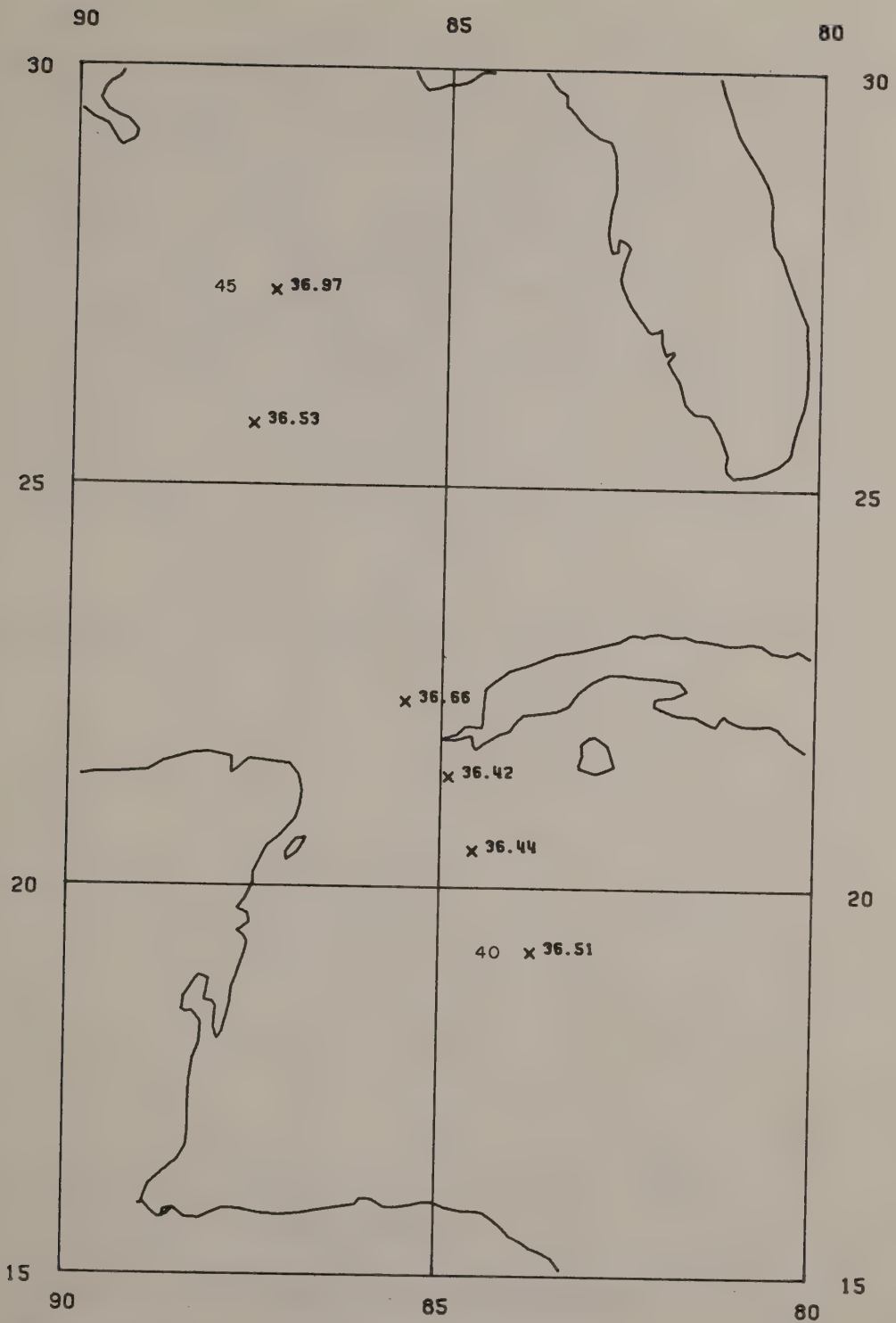


Figure 11.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Gulf Shipper*, 6-7 June 1972.

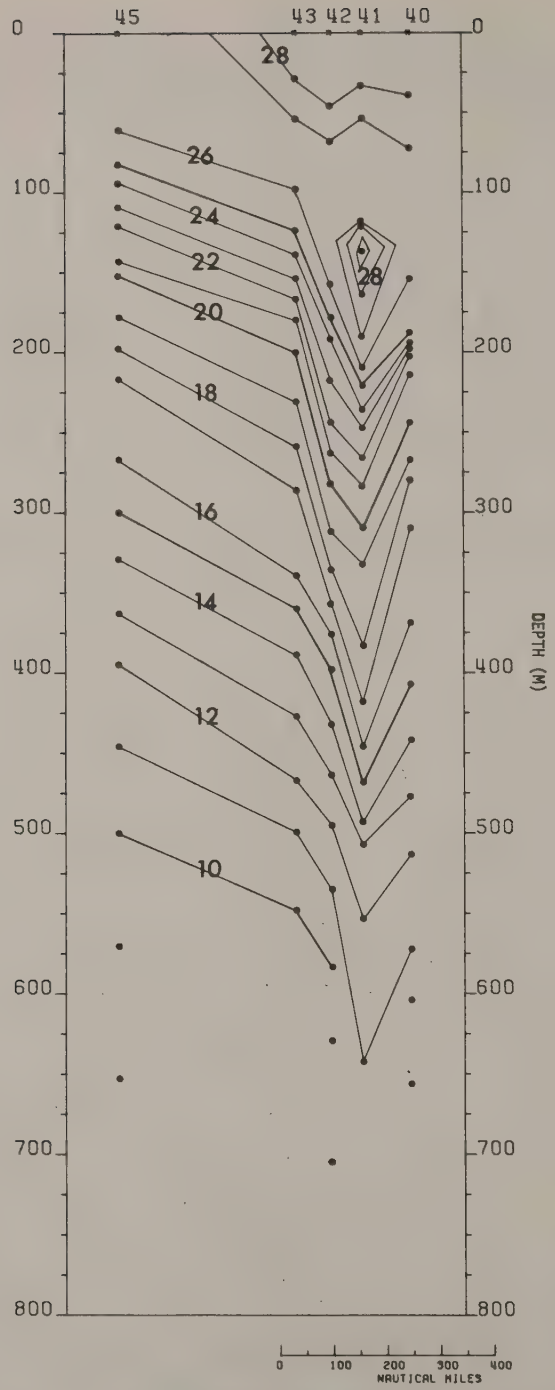


Figure 12.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Gulf Shipper*, 6-7 June 1972.

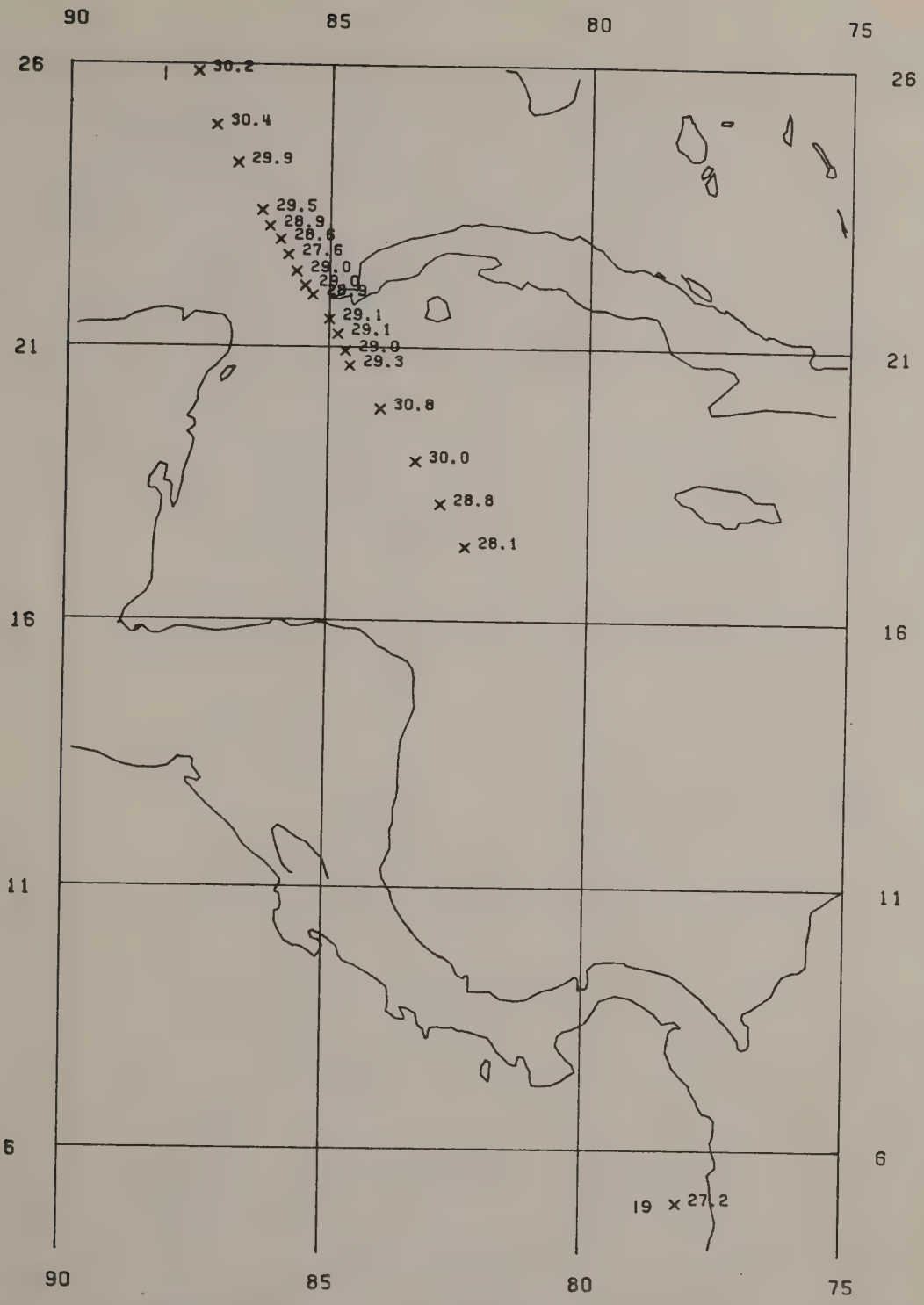


Figure 13.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Gulf Shipper*, 21-28 August 1972.

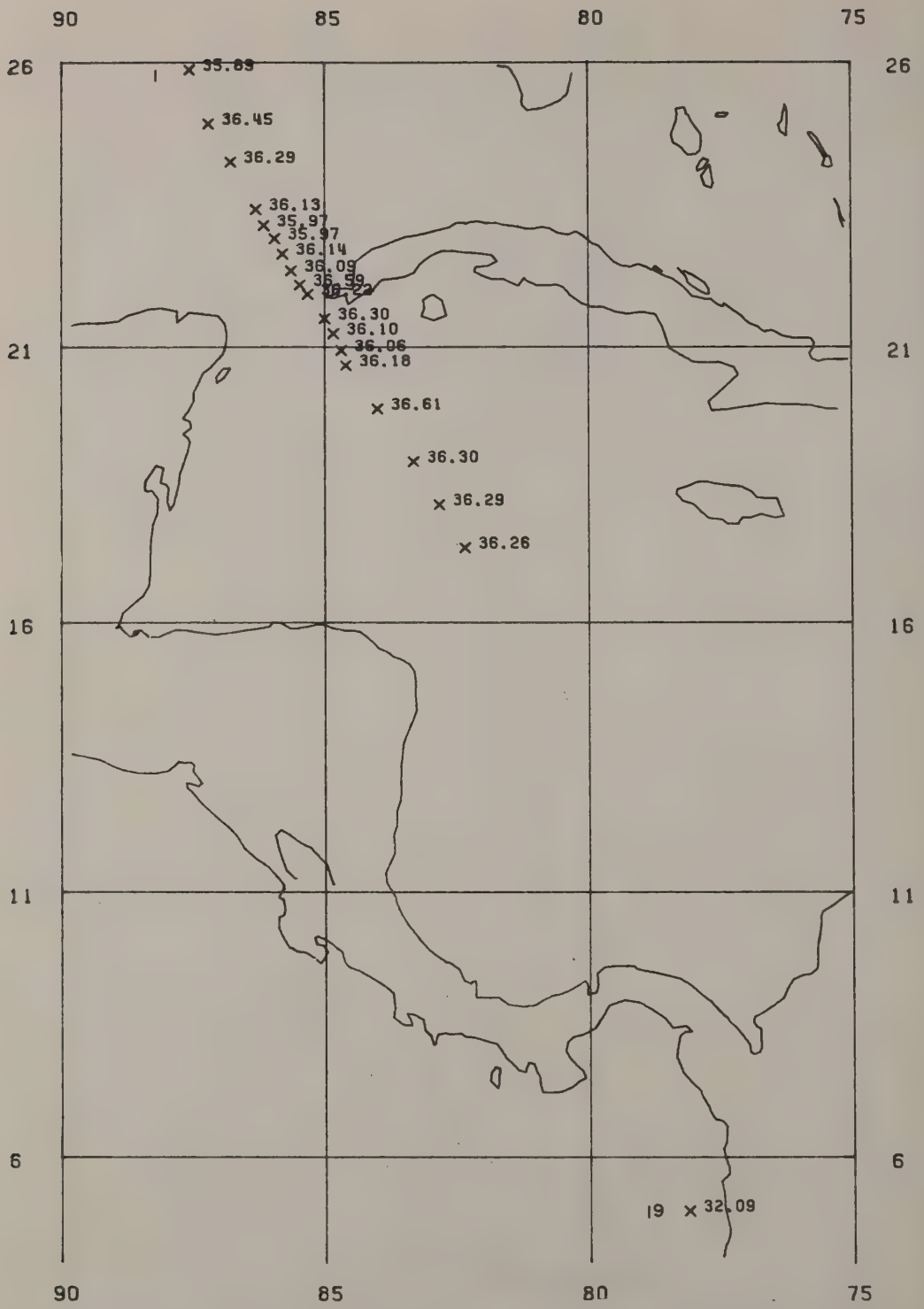


Figure 14.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Gulf Shipper*, 21-28 August 1972.

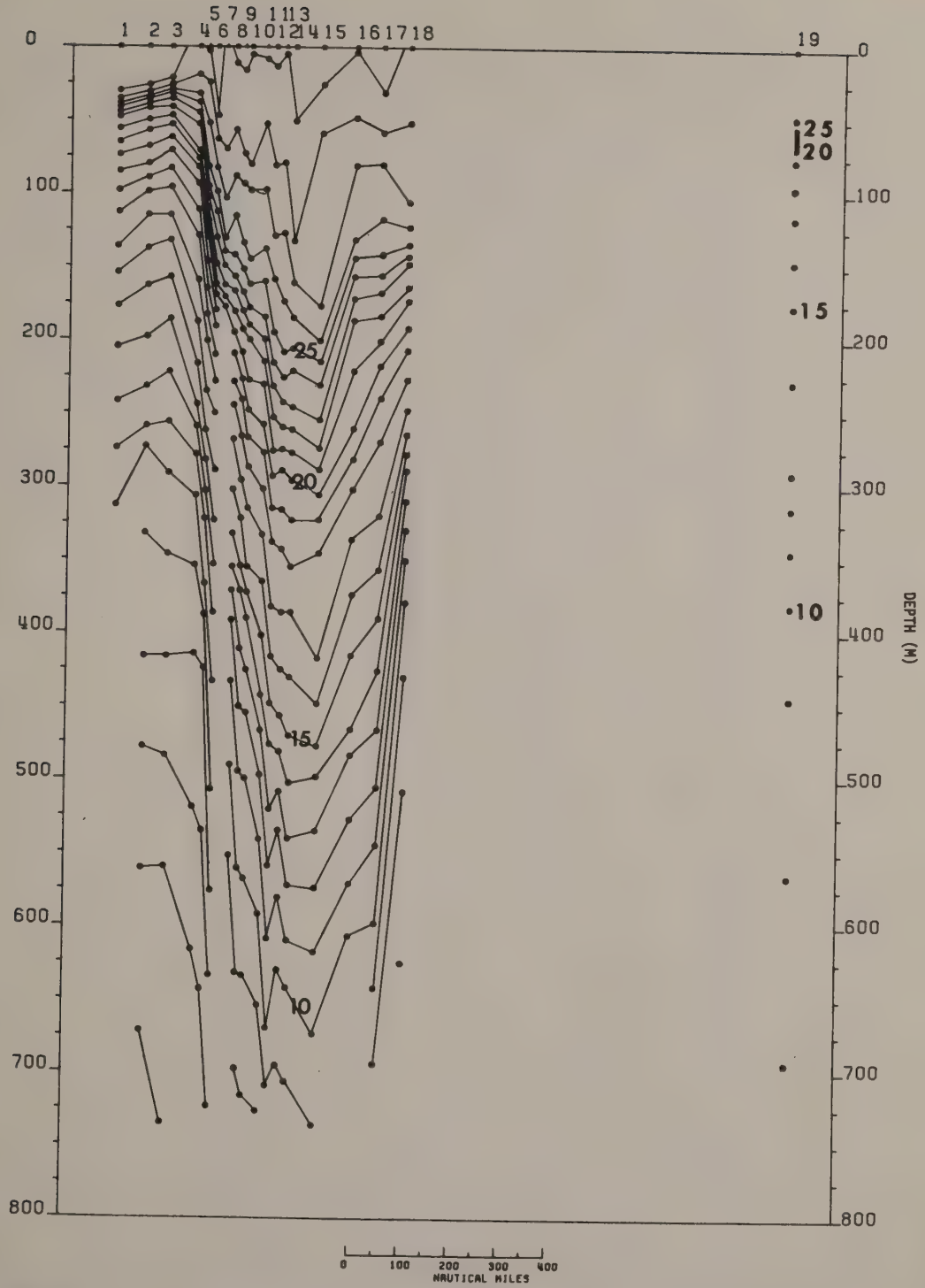


Figure 15.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Gulf Shipper*, **21-28 August 1972.**

Figure 16.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Delta Argentina*, **14-18 November 1972.**

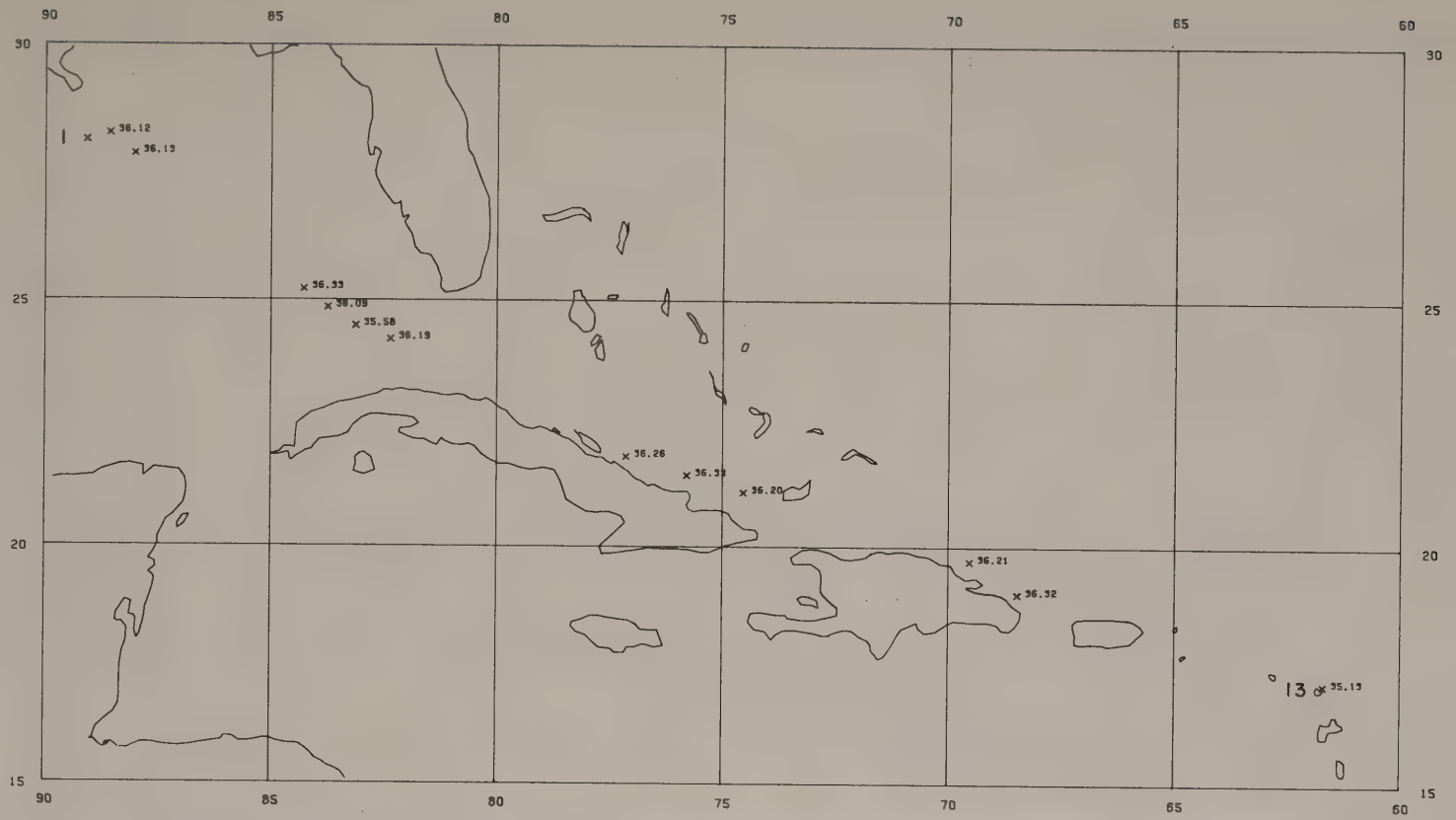


Figure 17.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Delta Argentina*, **14-18 November 1972.**

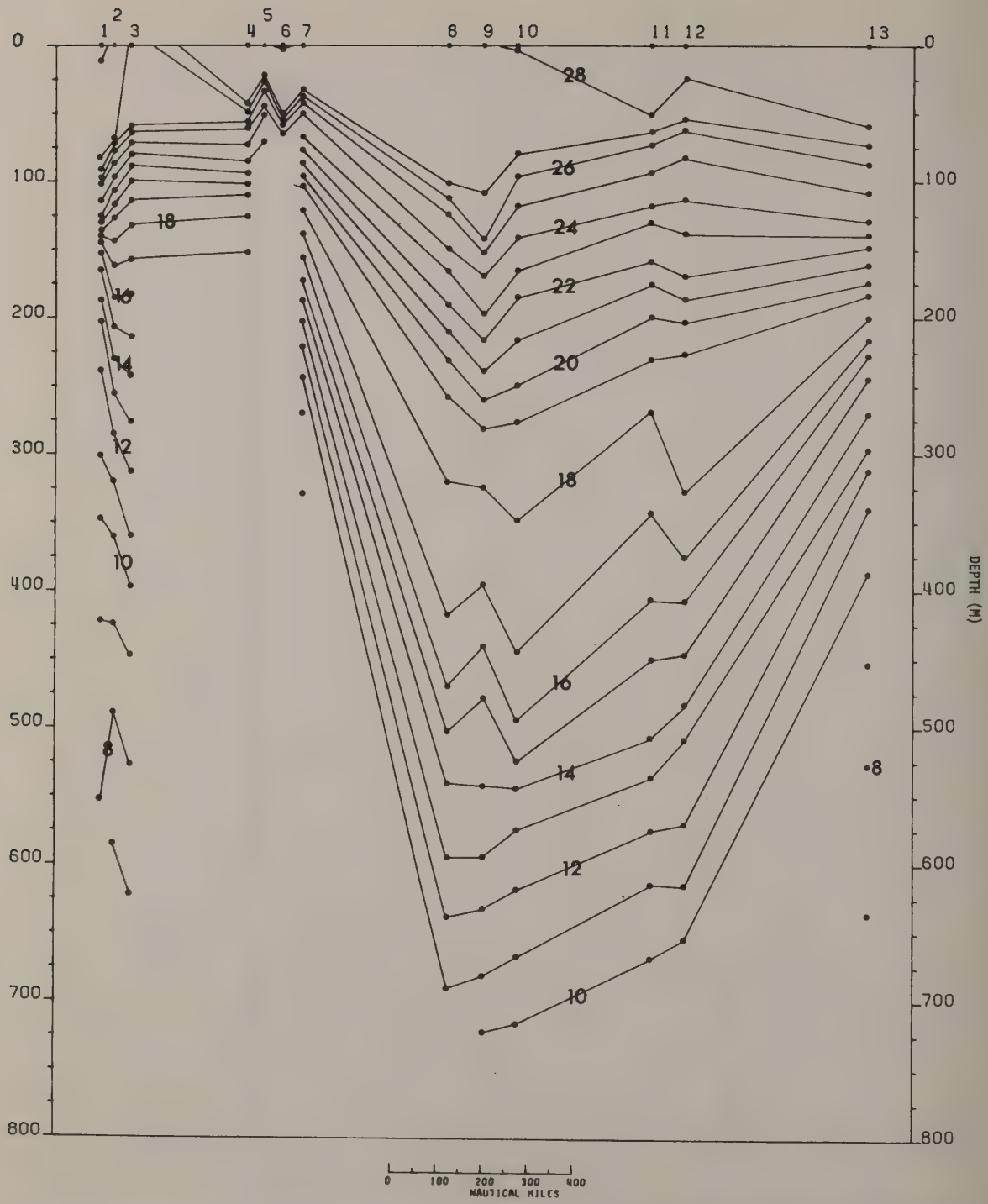


Figure 18.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Delta Argentina*, 14-18 November 1972.

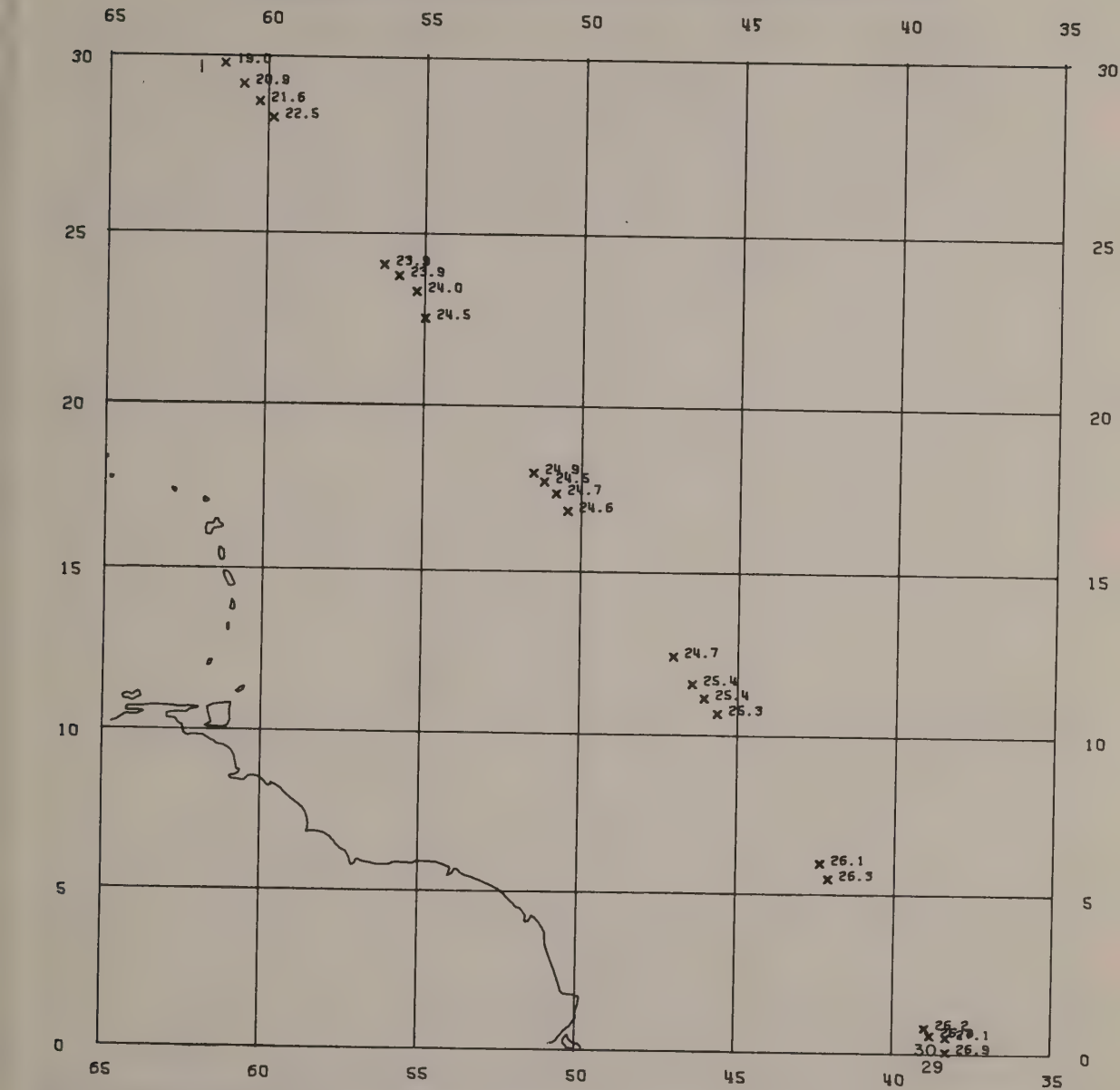


Figure 19.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Mormac Trade*, 27 January-1 February 1972.

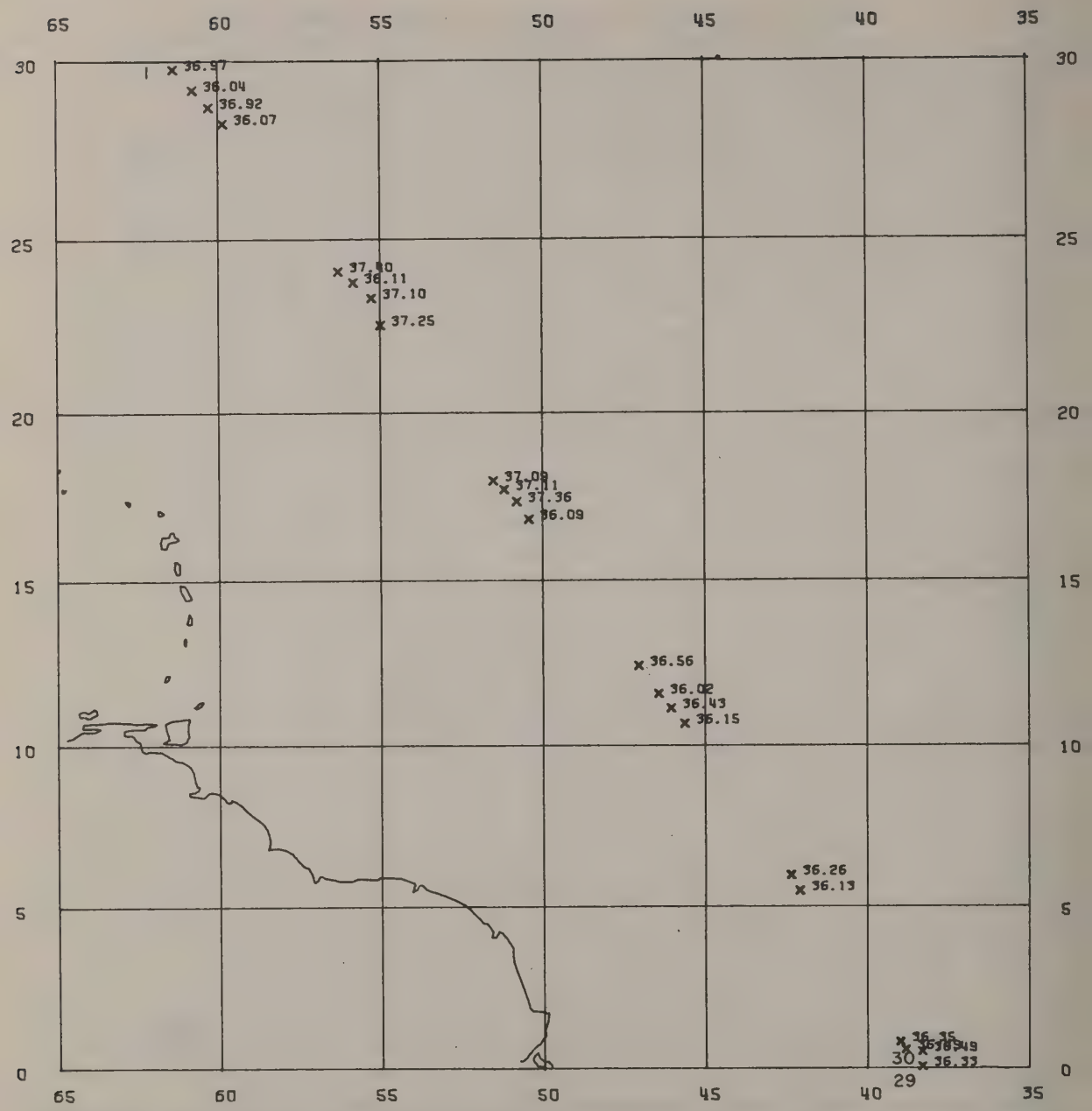


Figure 20.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Mormac Trade*, **27 January - 1 February 1972.**

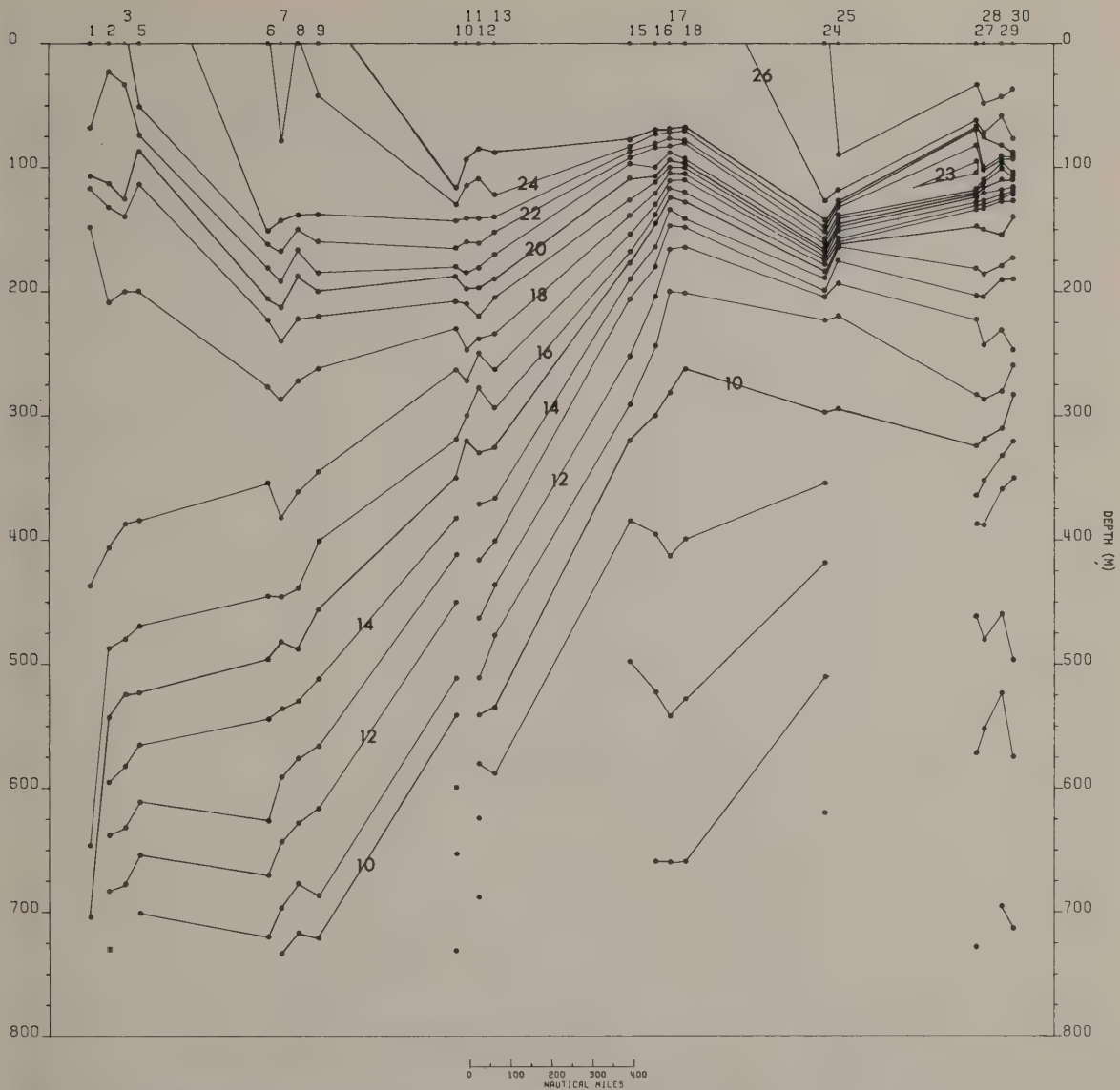


Figure 21.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Mormac Trade*, **27 January-1 February 1972.**

Figure 22.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Bay State*, **10-14 February 1972.**

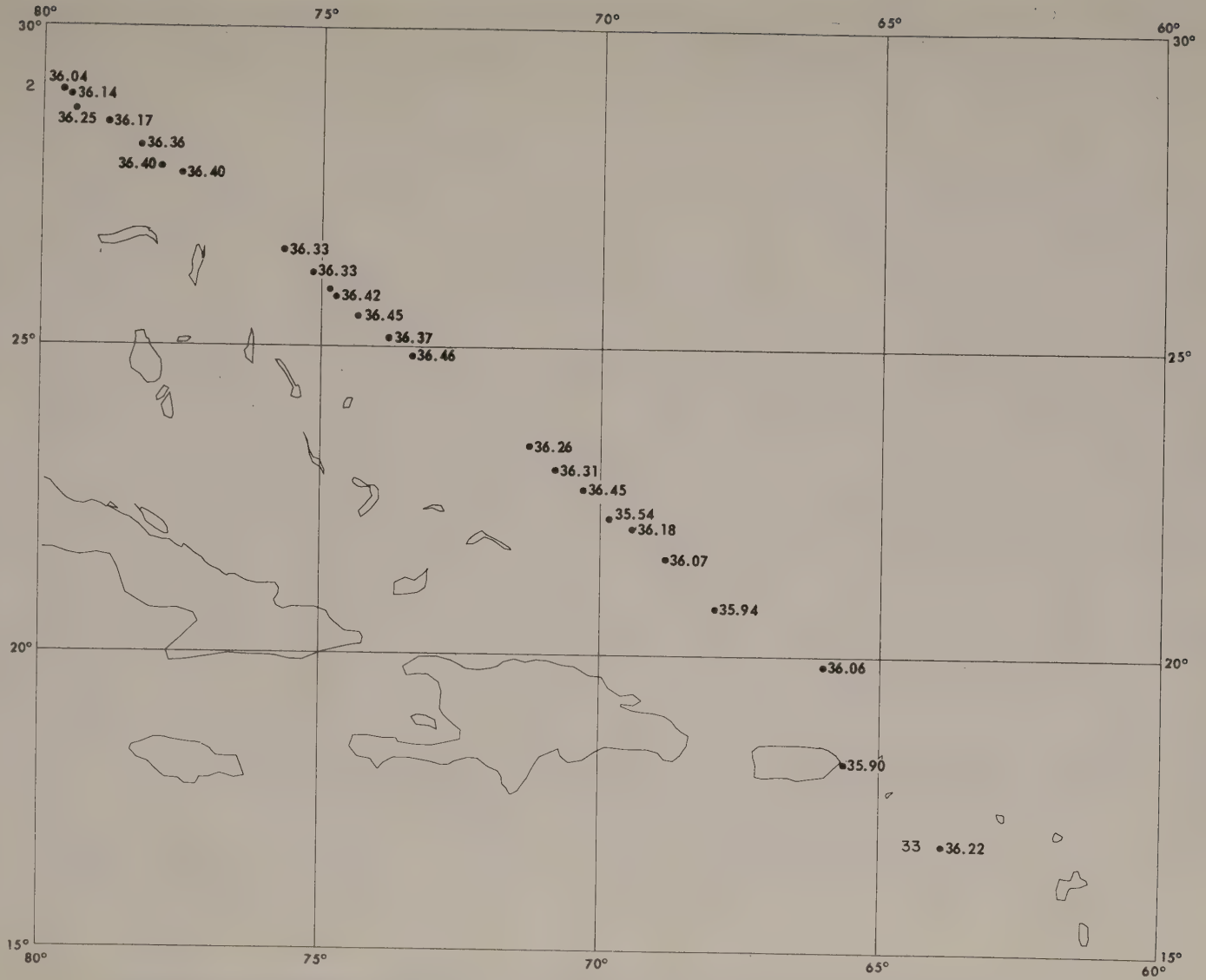


Figure 23.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Bay State*, 10-14 February 1972.

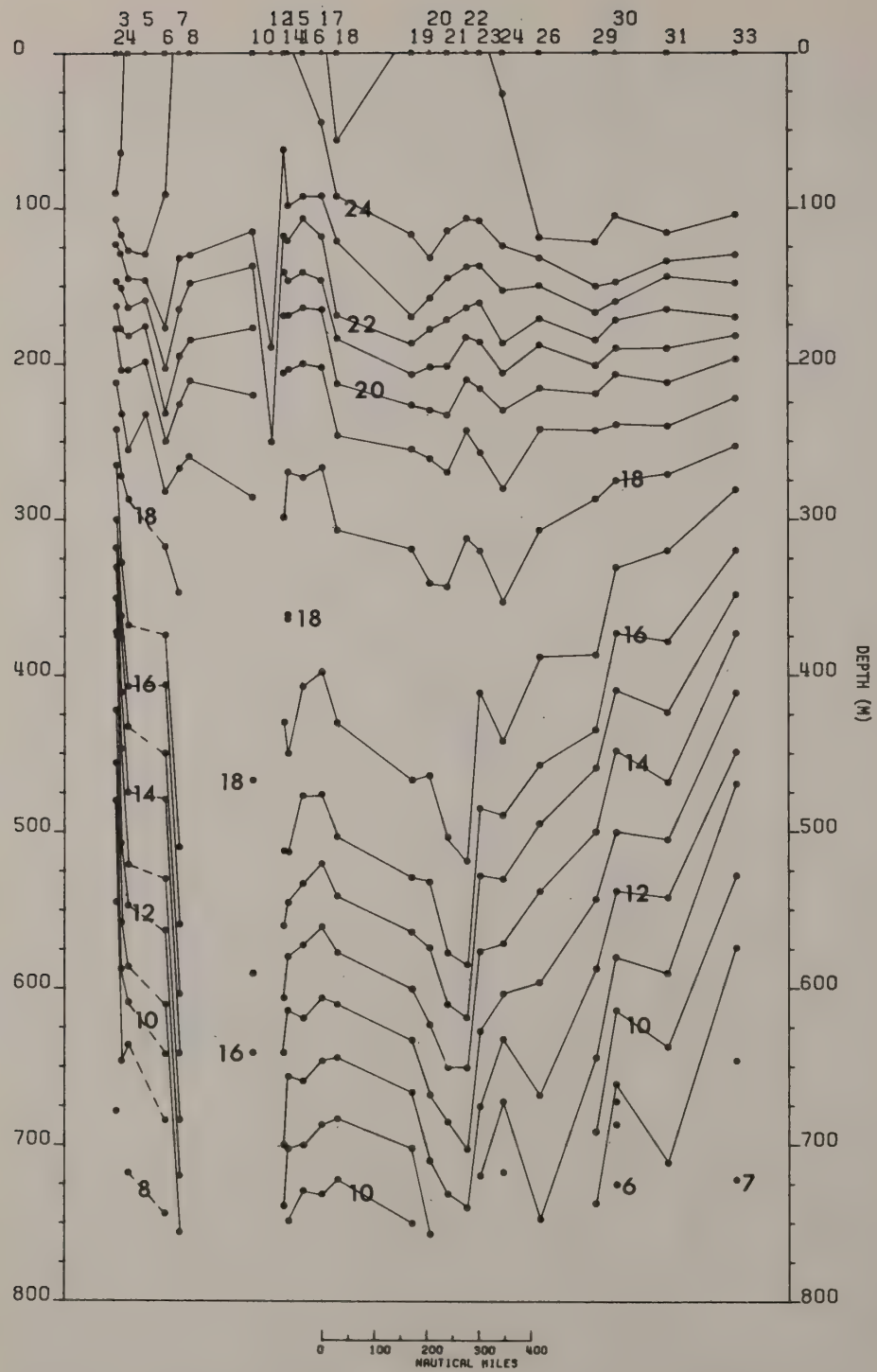


Figure 24.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Bay State*, 10-14 February 1972.

Figure 25.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Bay State*, **19-23 February 1972.**

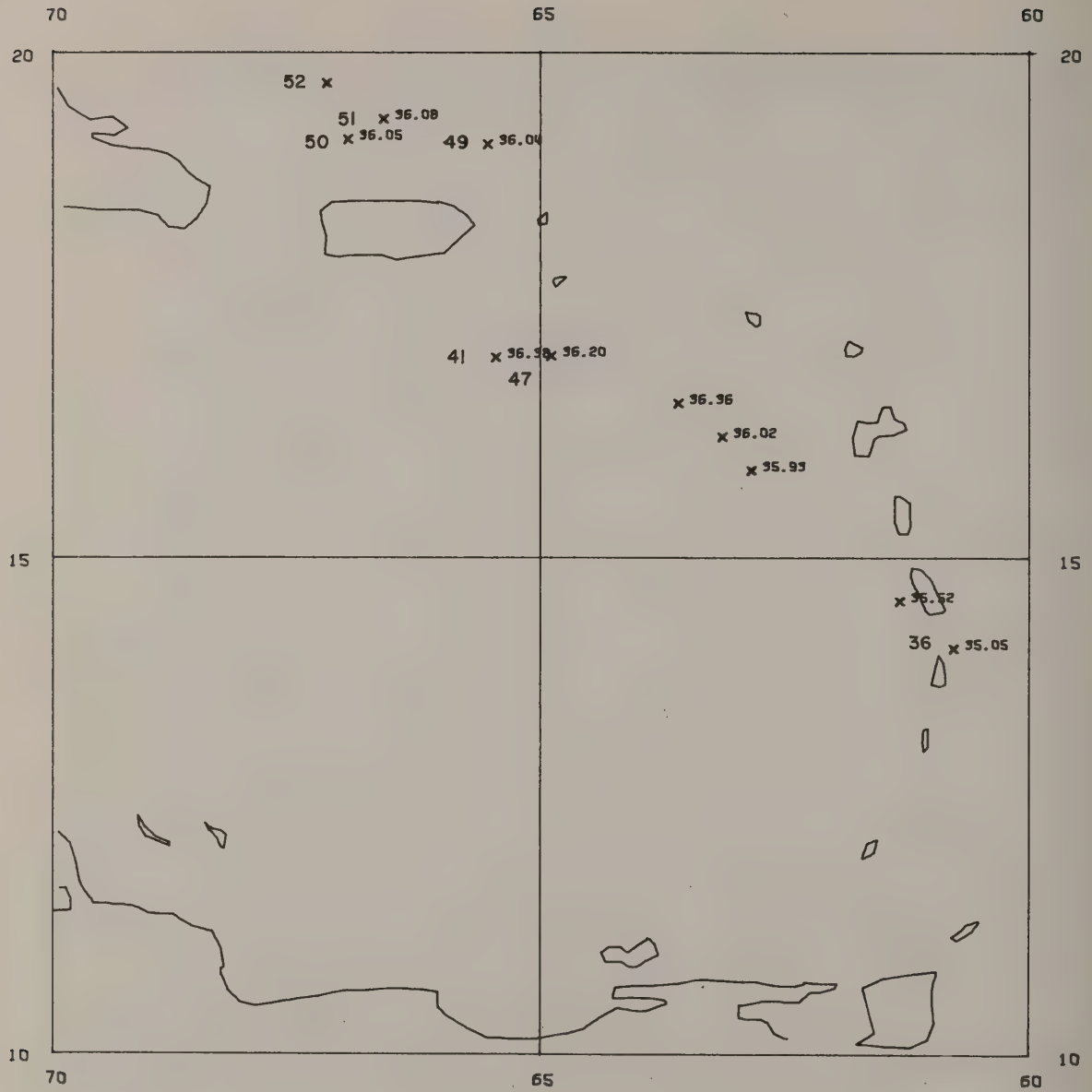


Figure 26.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Bay State*. 19-23 February 1972.

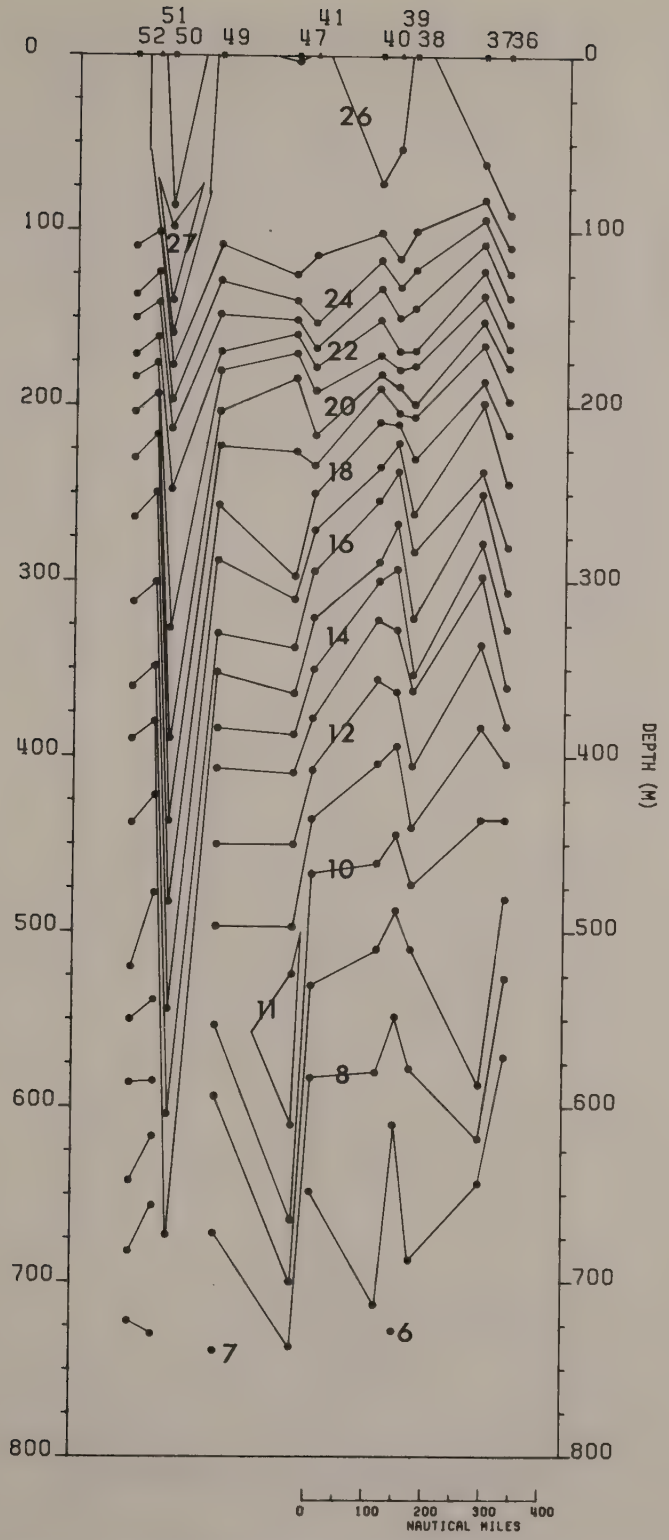


Figure 27.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Bay State*, 19-23 February 1972.

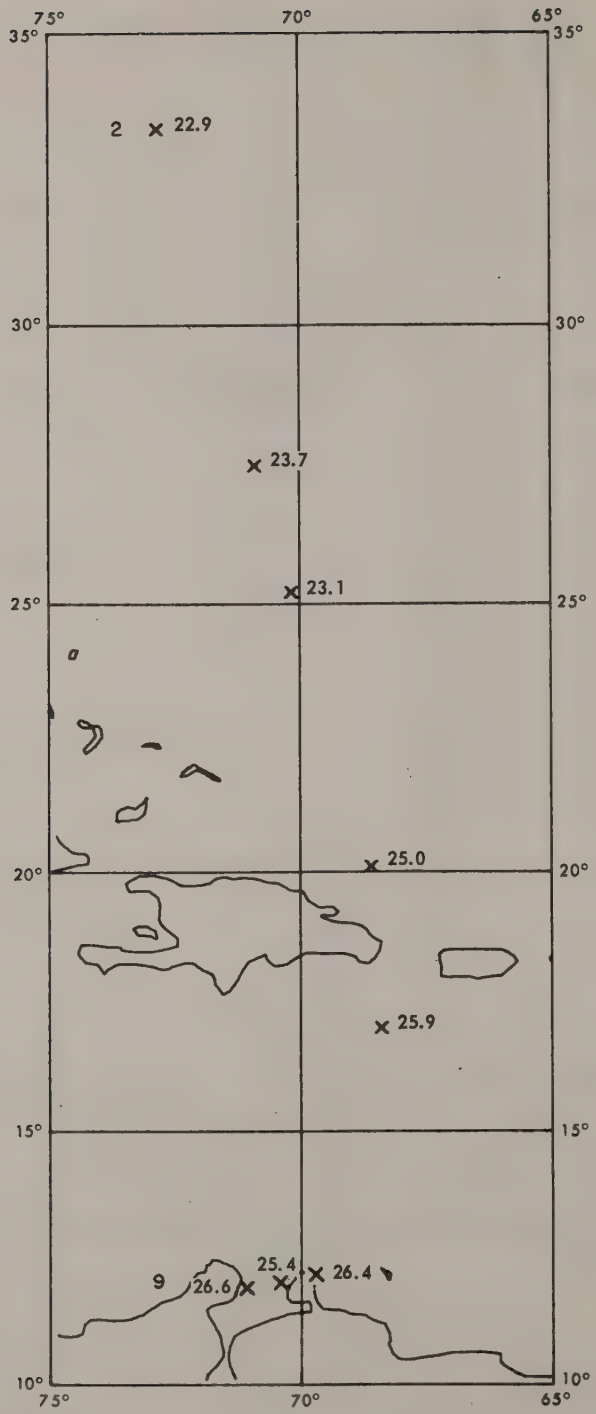


Figure 28.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz.* **13-25 March 1972.**

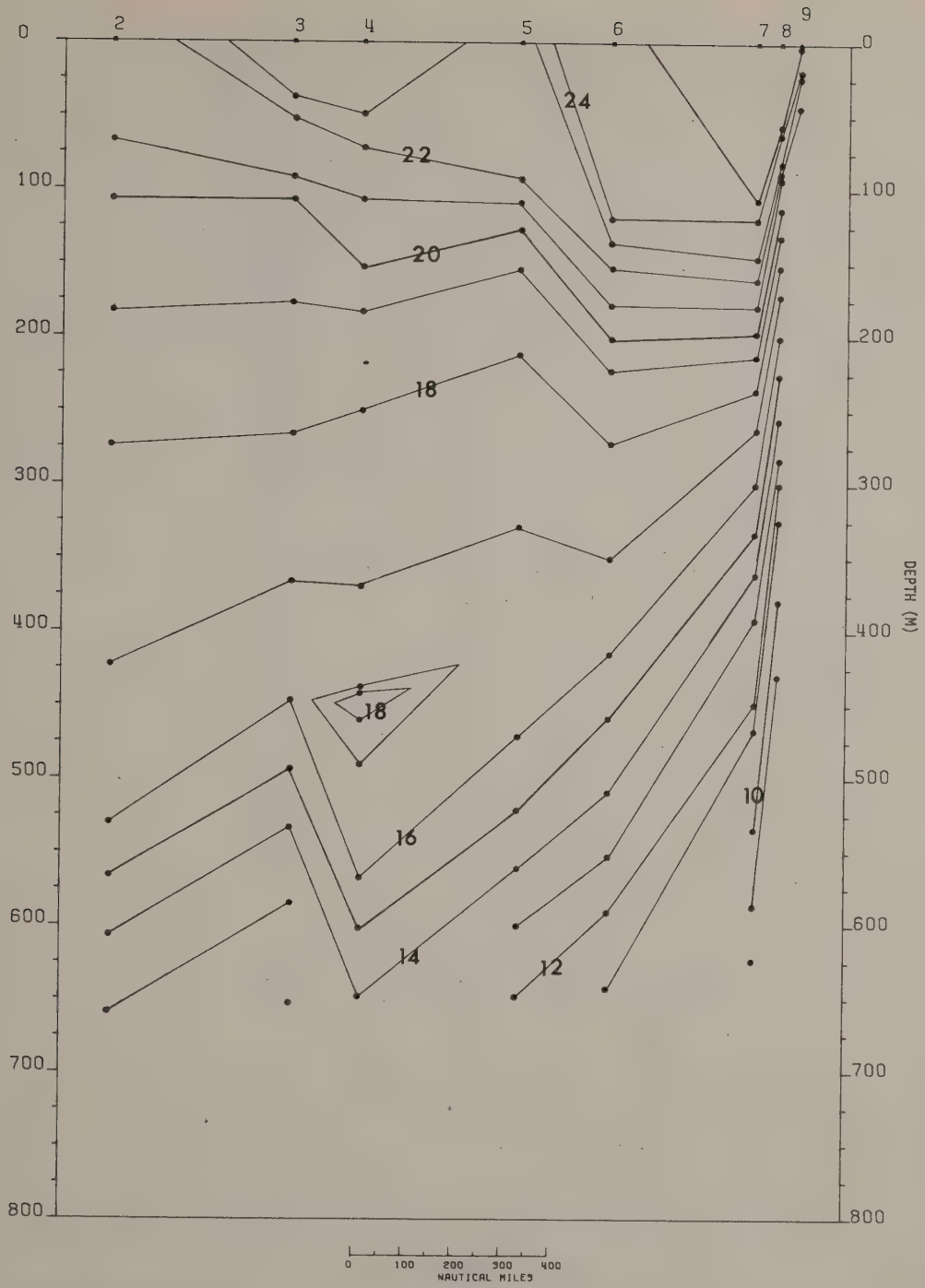


Figure 29.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **13-25 March 1972.**

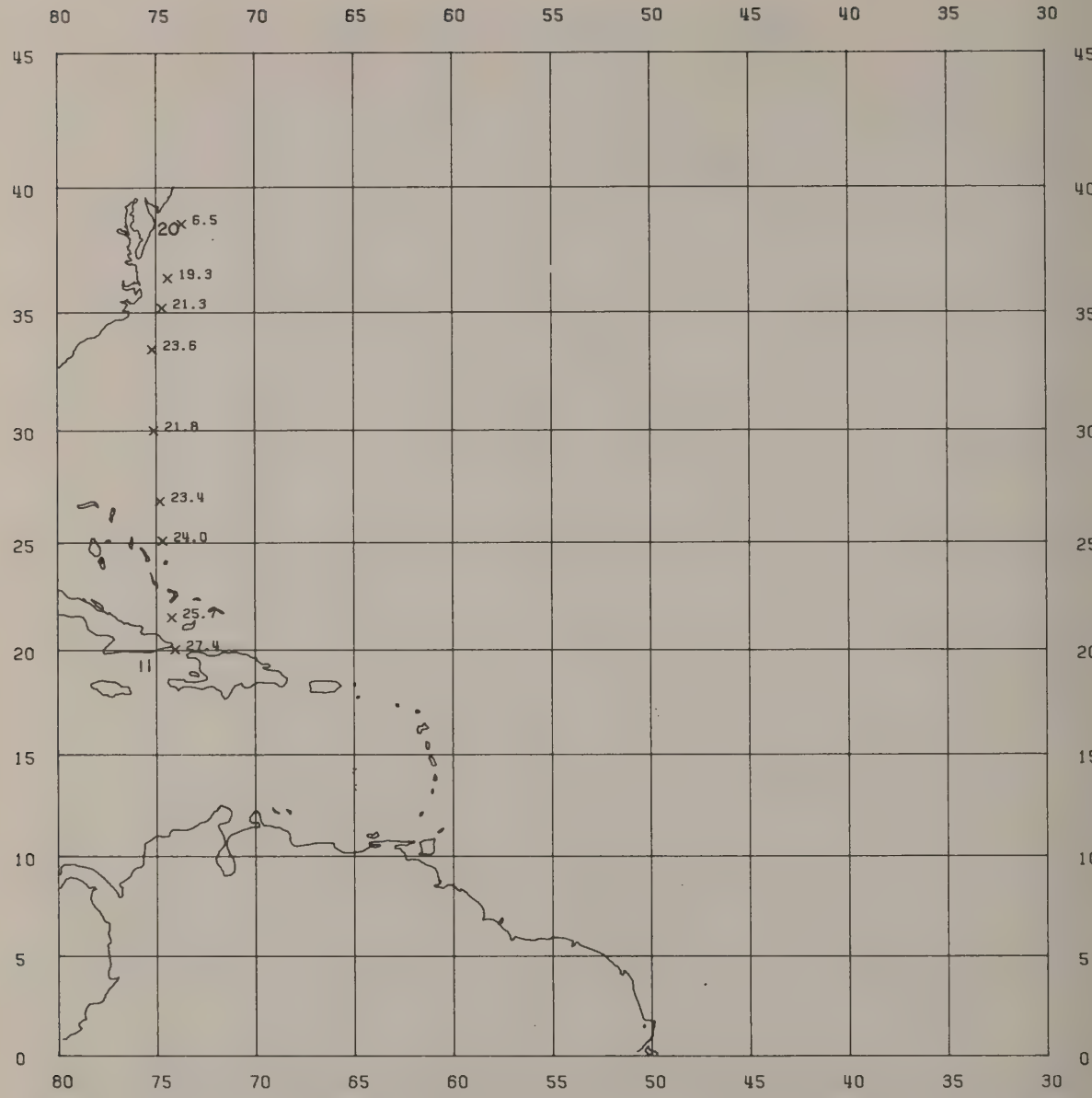


Figure 30.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, **26-29 March 1972.**

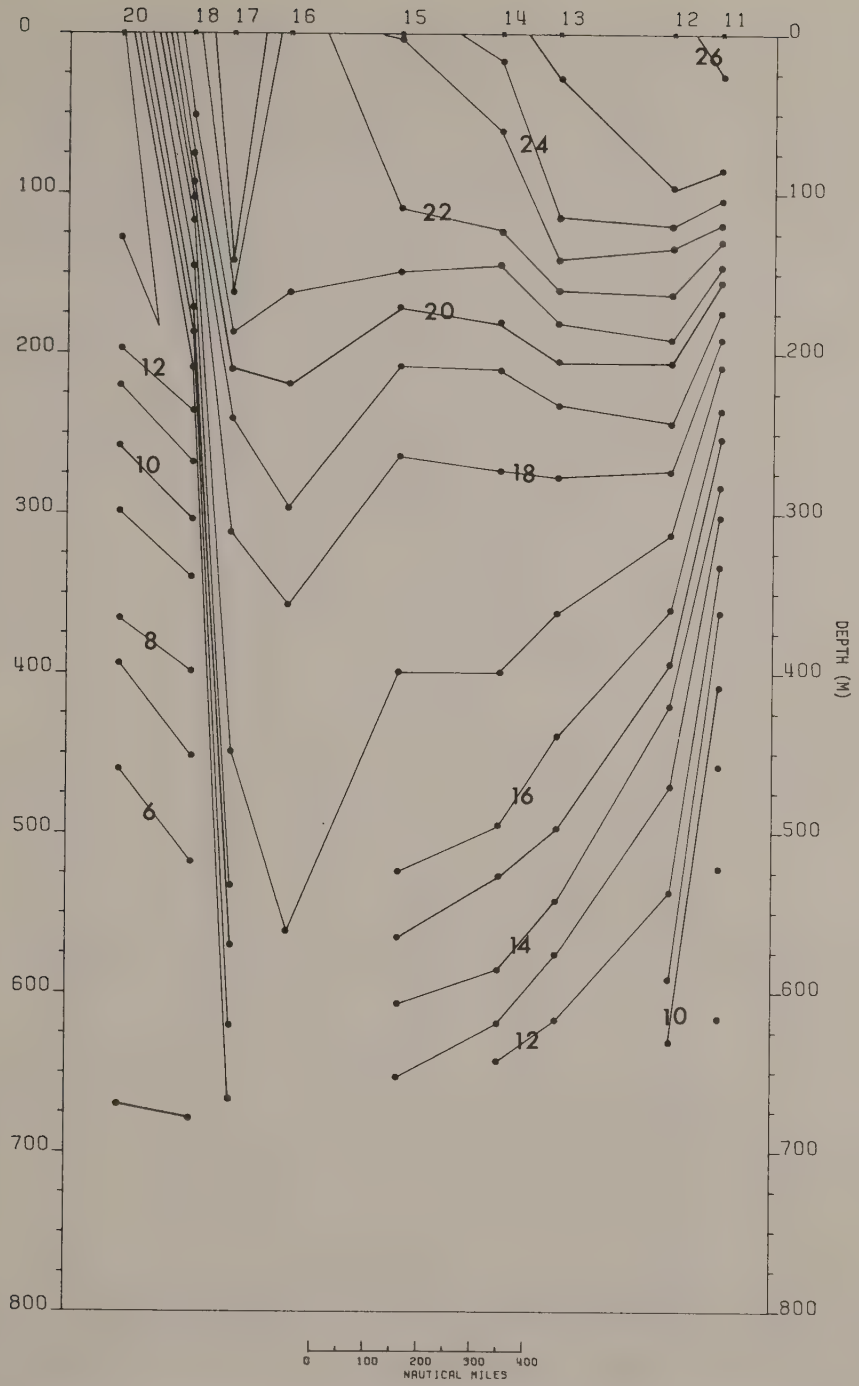


Figure 31.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **26-29 March 1972.**

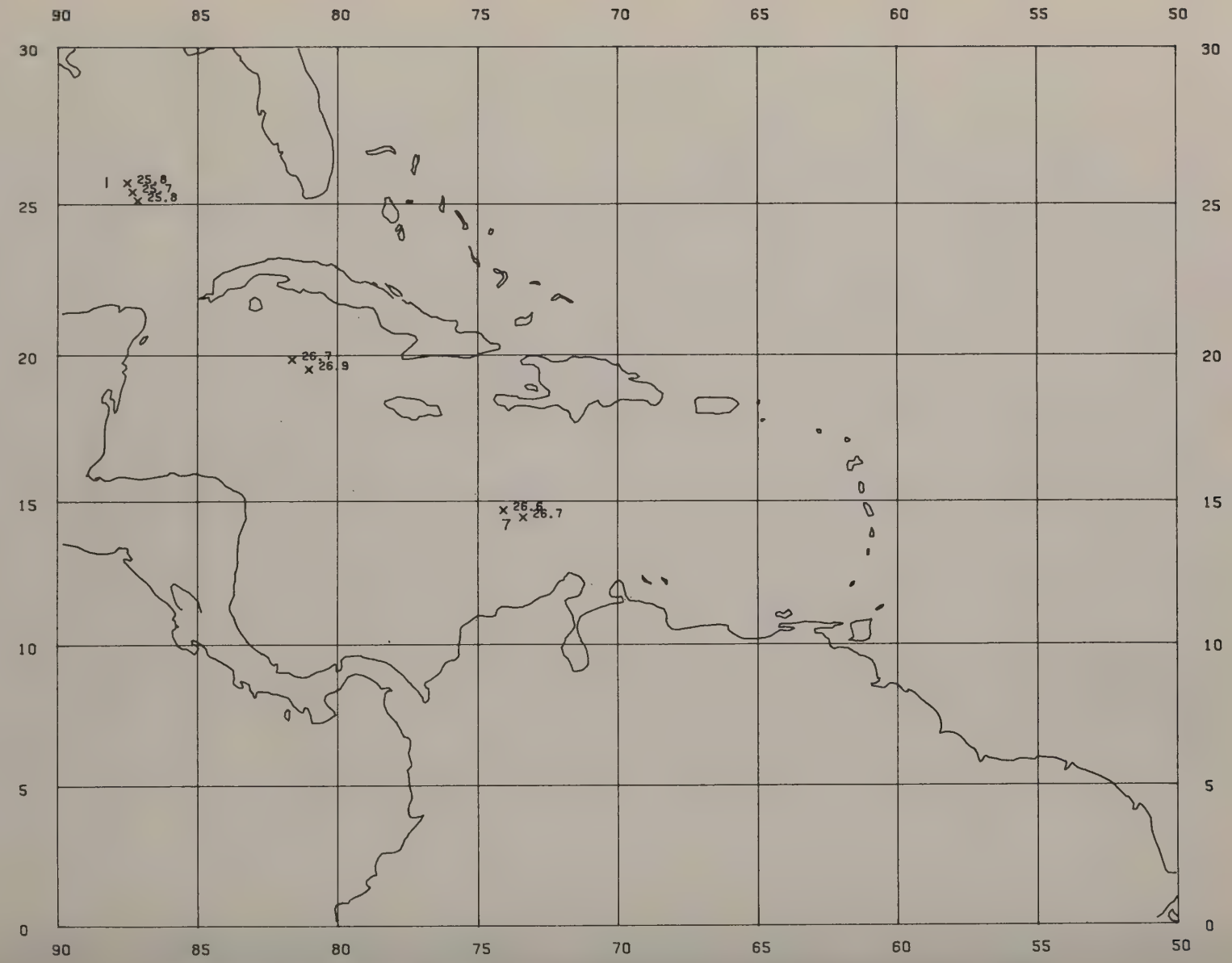


Figure 32.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Delta Brazil,* **1-3 April 1972.**

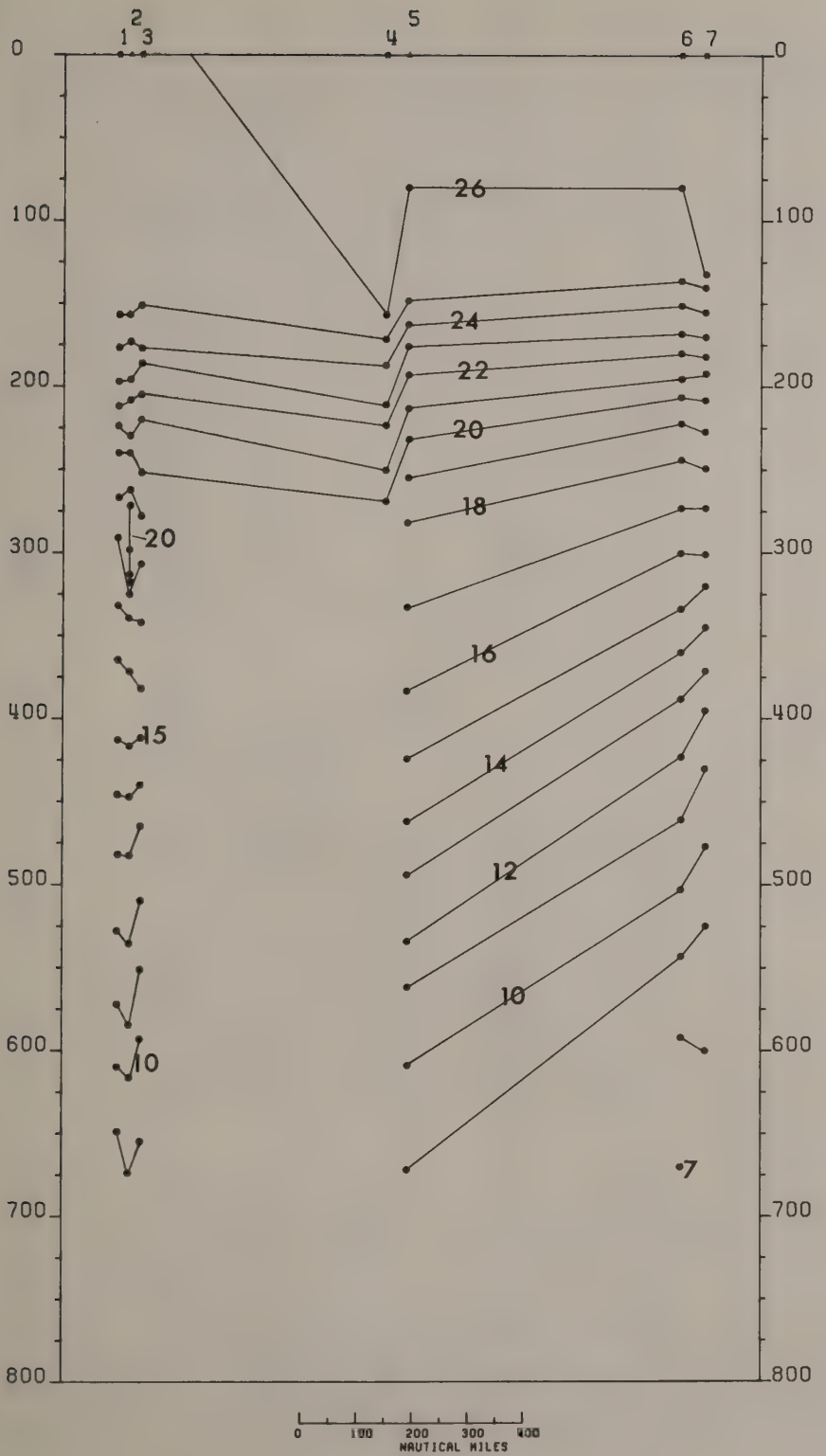


Figure 33.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Delta Brazil*, 1-3 April 1972.

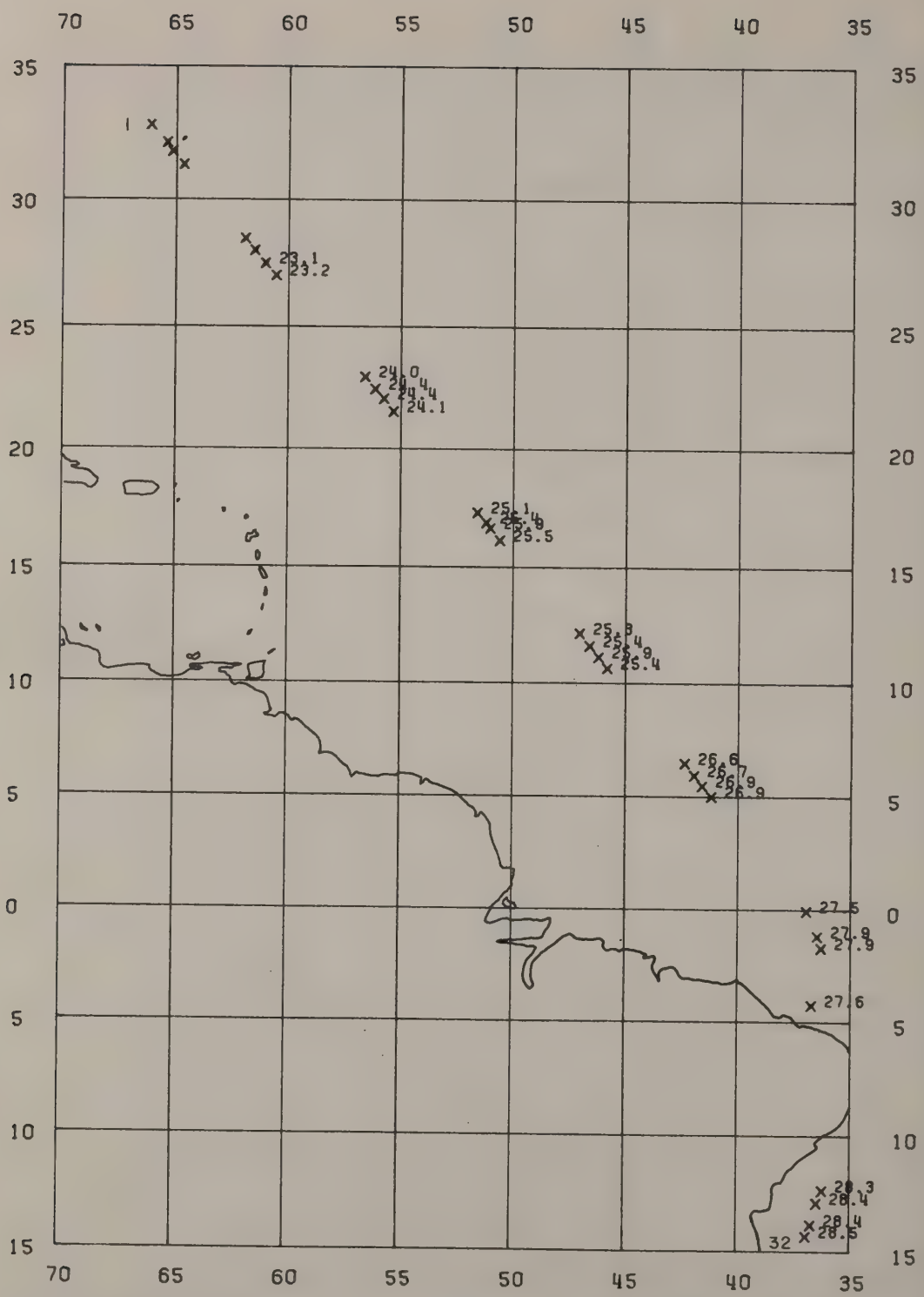


Figure 34.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Mormac Cape*, **9-17 April 1972.**

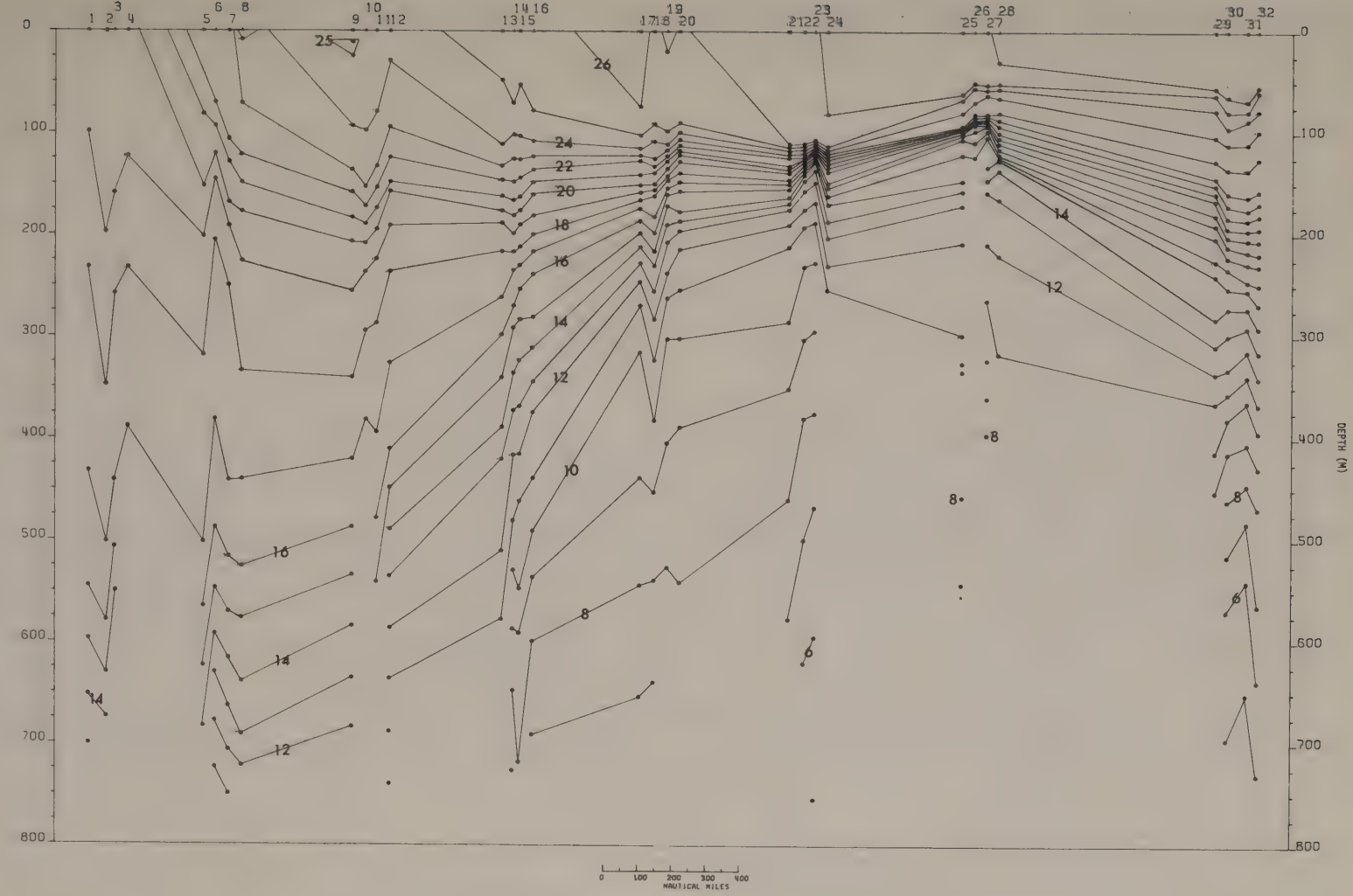


Figure 35.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Mormac Cape*, 9-17 April 1972.

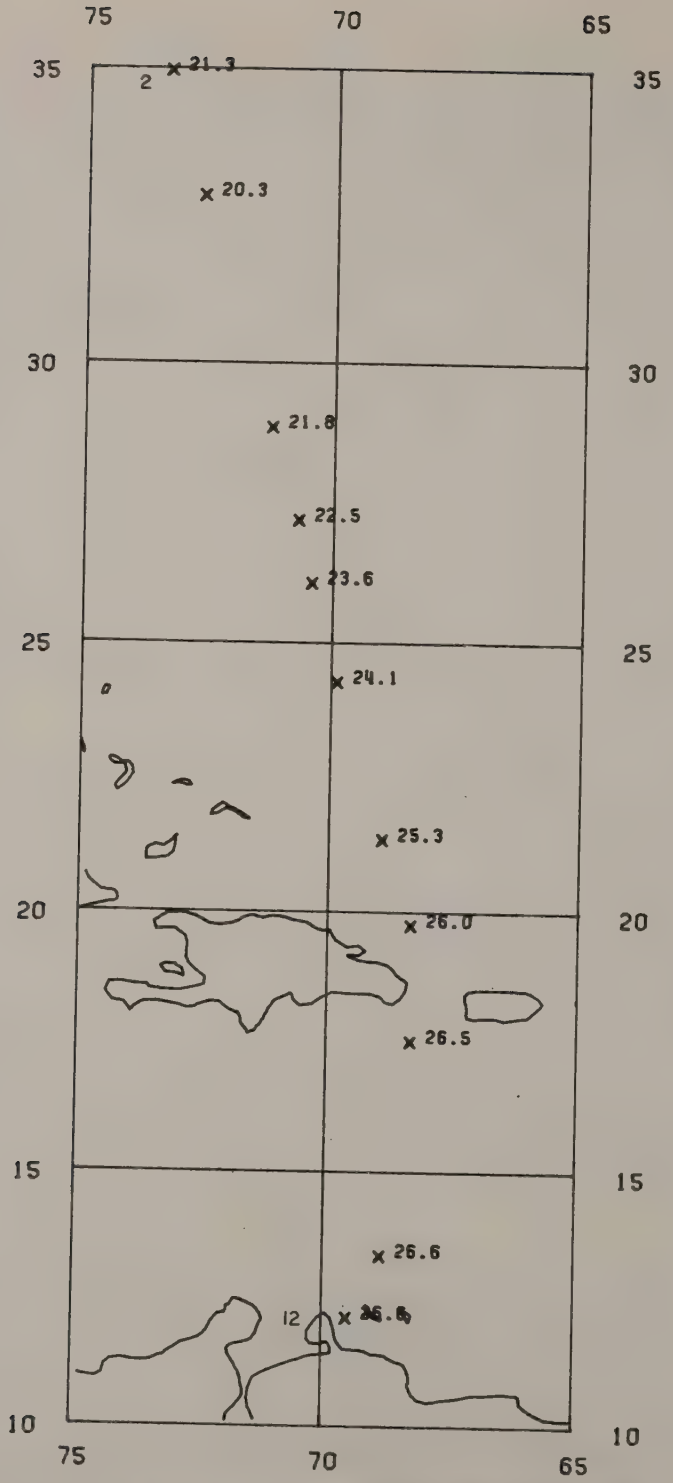


Figure 36.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, **4-8 April 1972.**

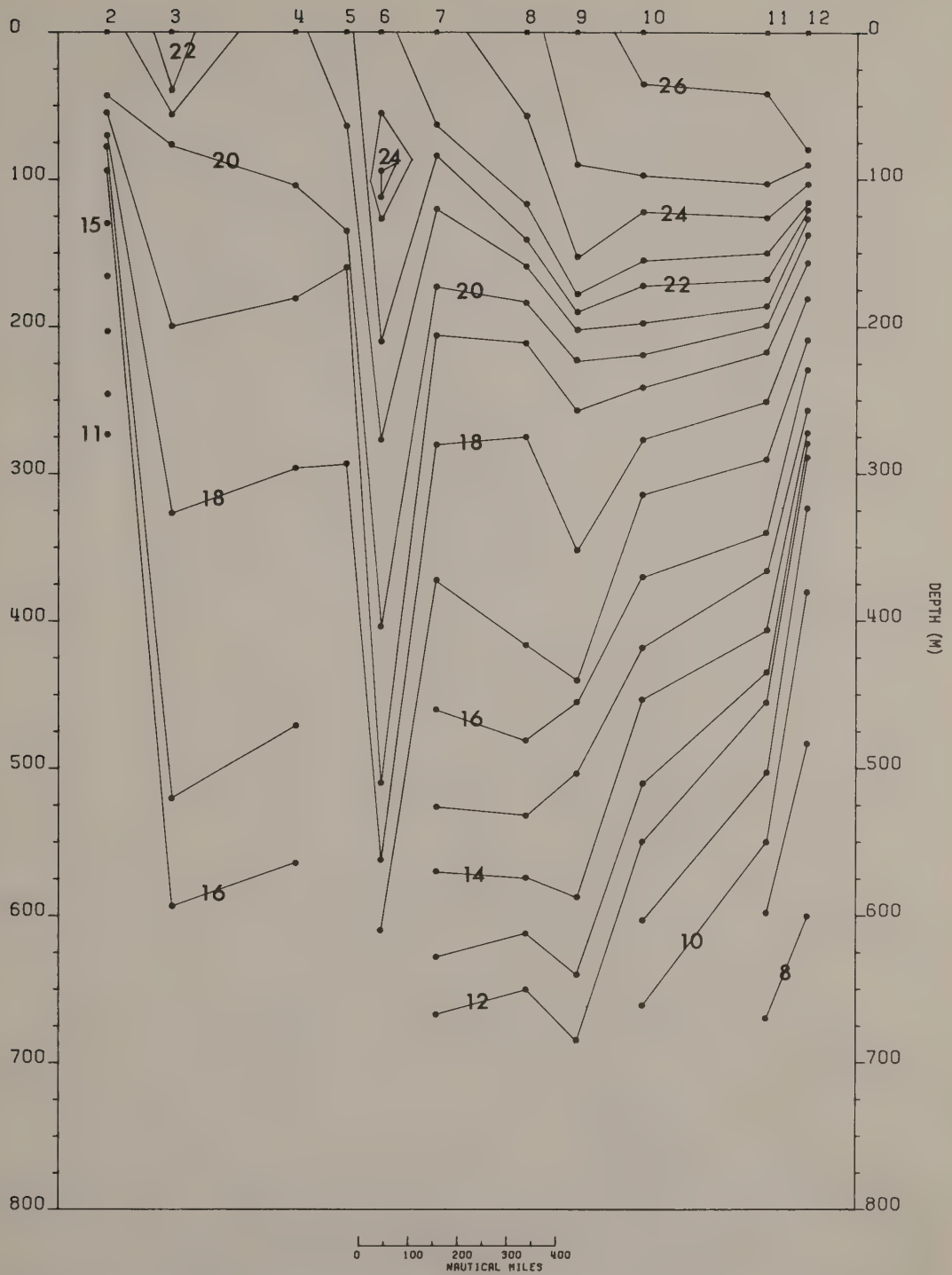


Figure 37.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **4-8 April 1972.**

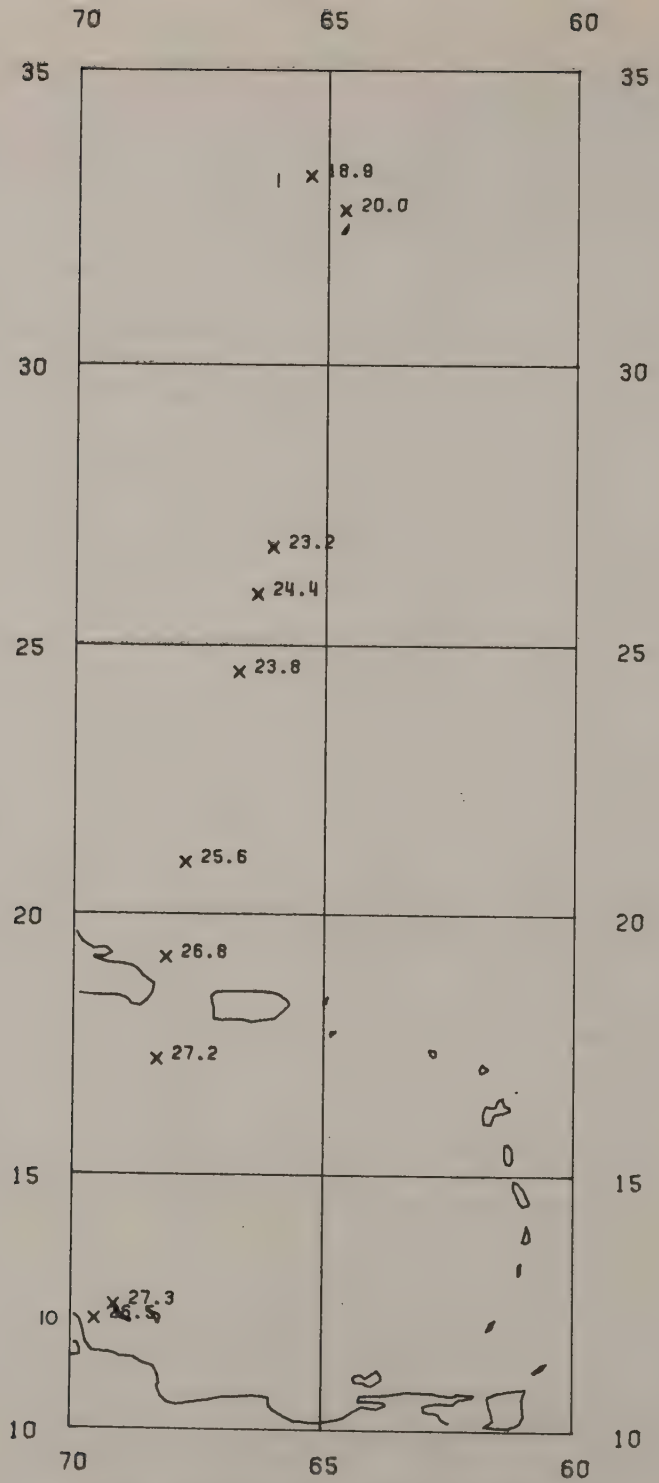


Figure 38.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz,* **1-5 May 1972.**

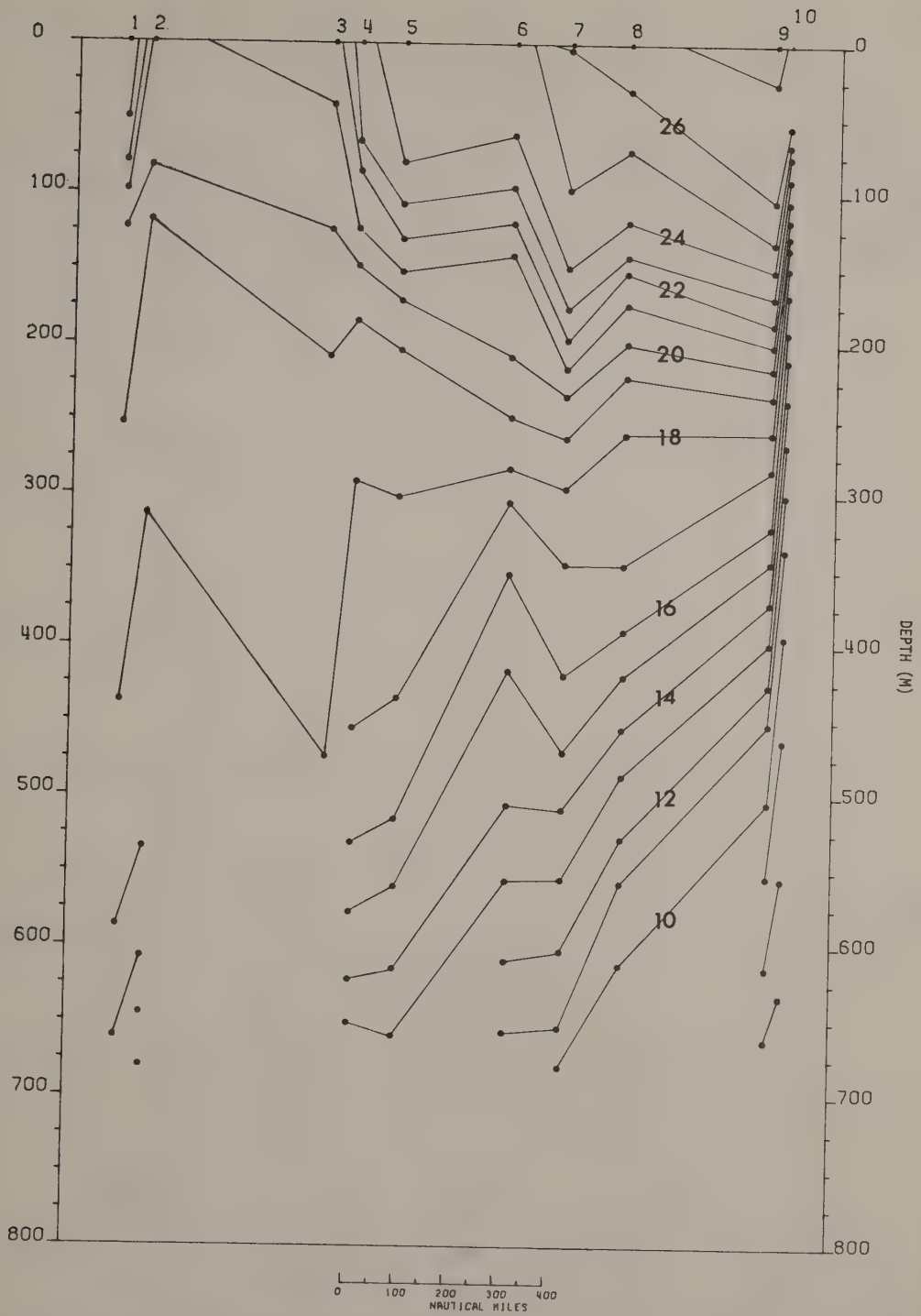


Figure 39.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **1-5 May 1972.**

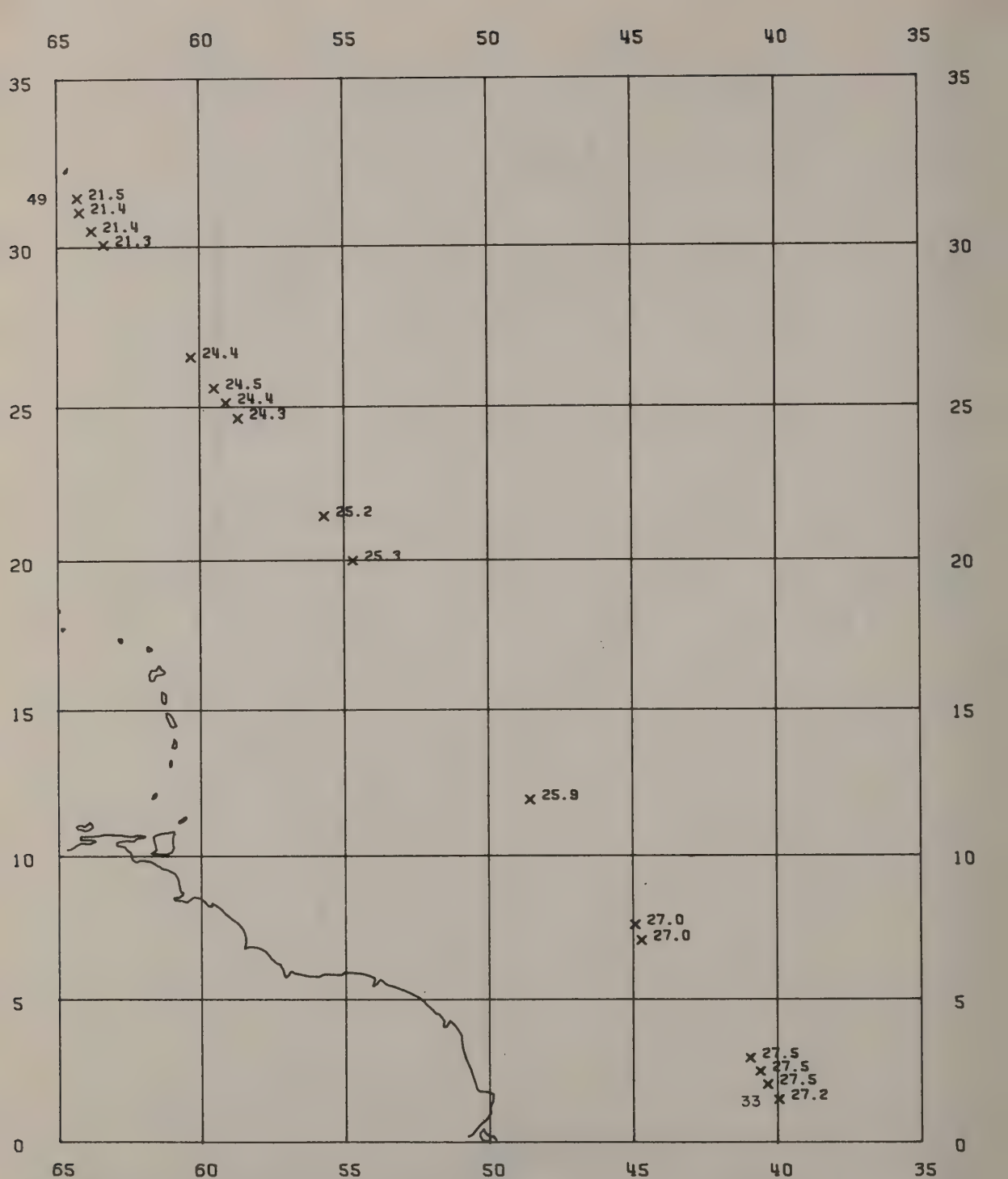


Figure 40.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Mormac Cape*, 20-25 May 1972.

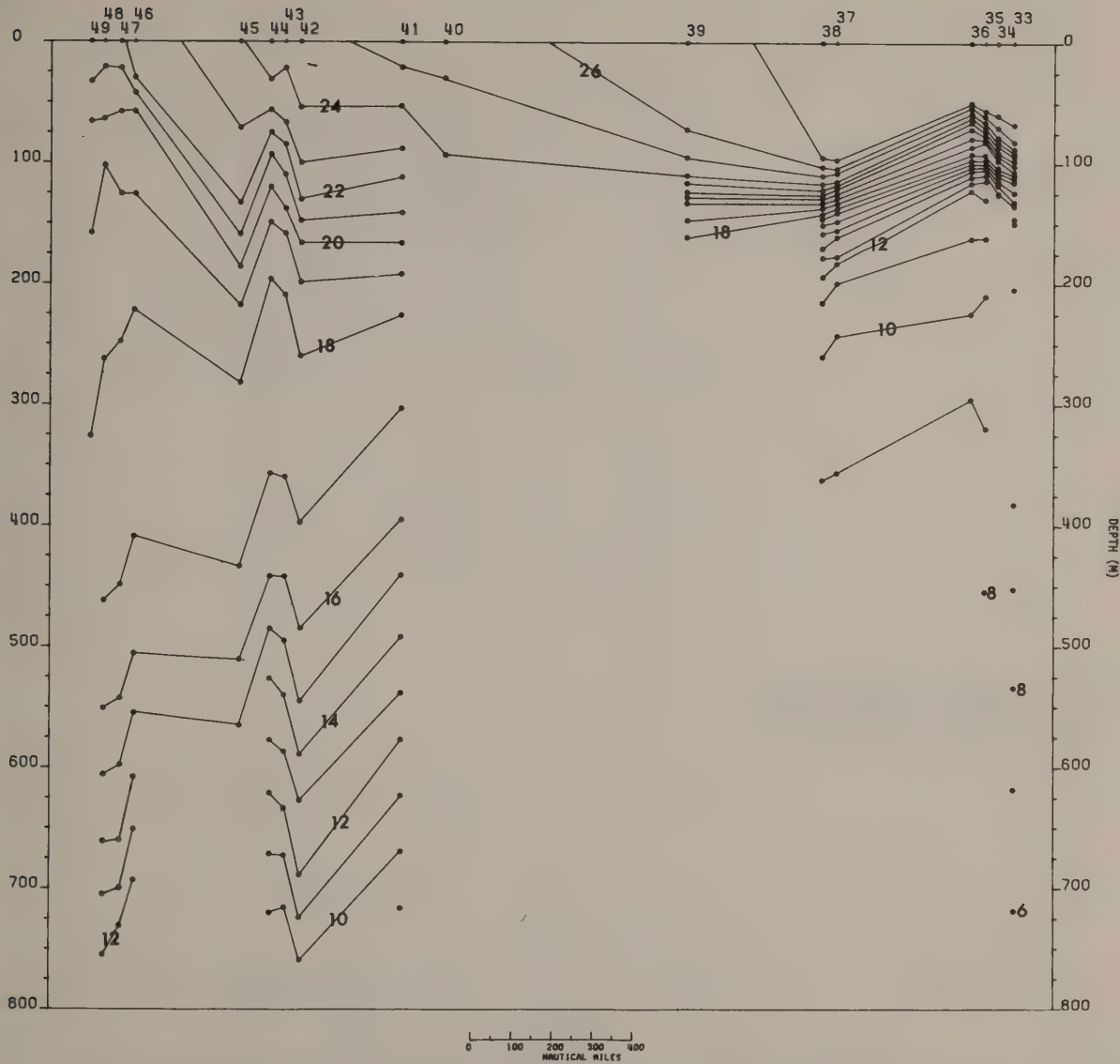


Figure 41.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Mormac Cape*, **20-25 May 1972.**

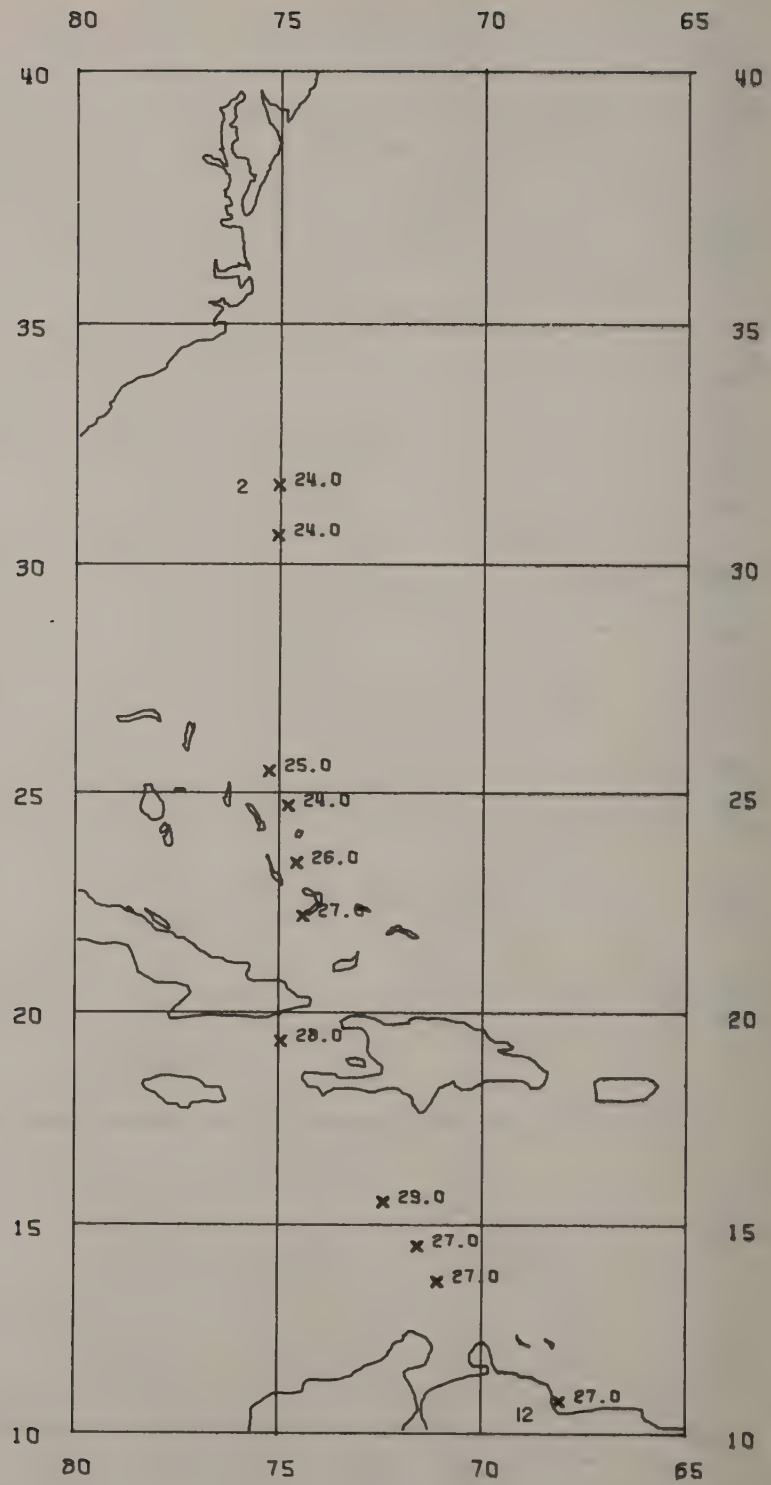


Figure 42.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz,* **29 May-8 June 1972.**

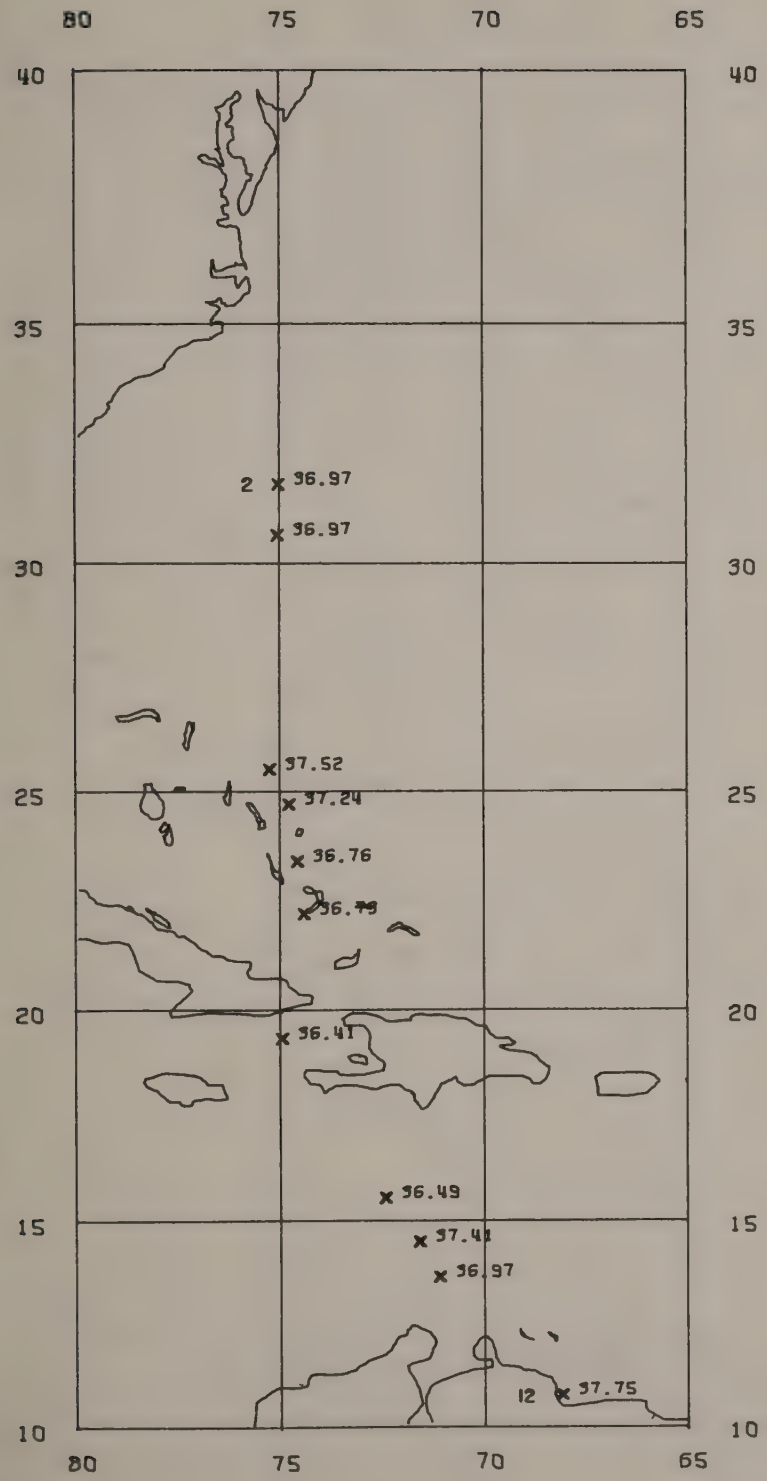


Figure 43.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, **29 May-8 June 1972.**

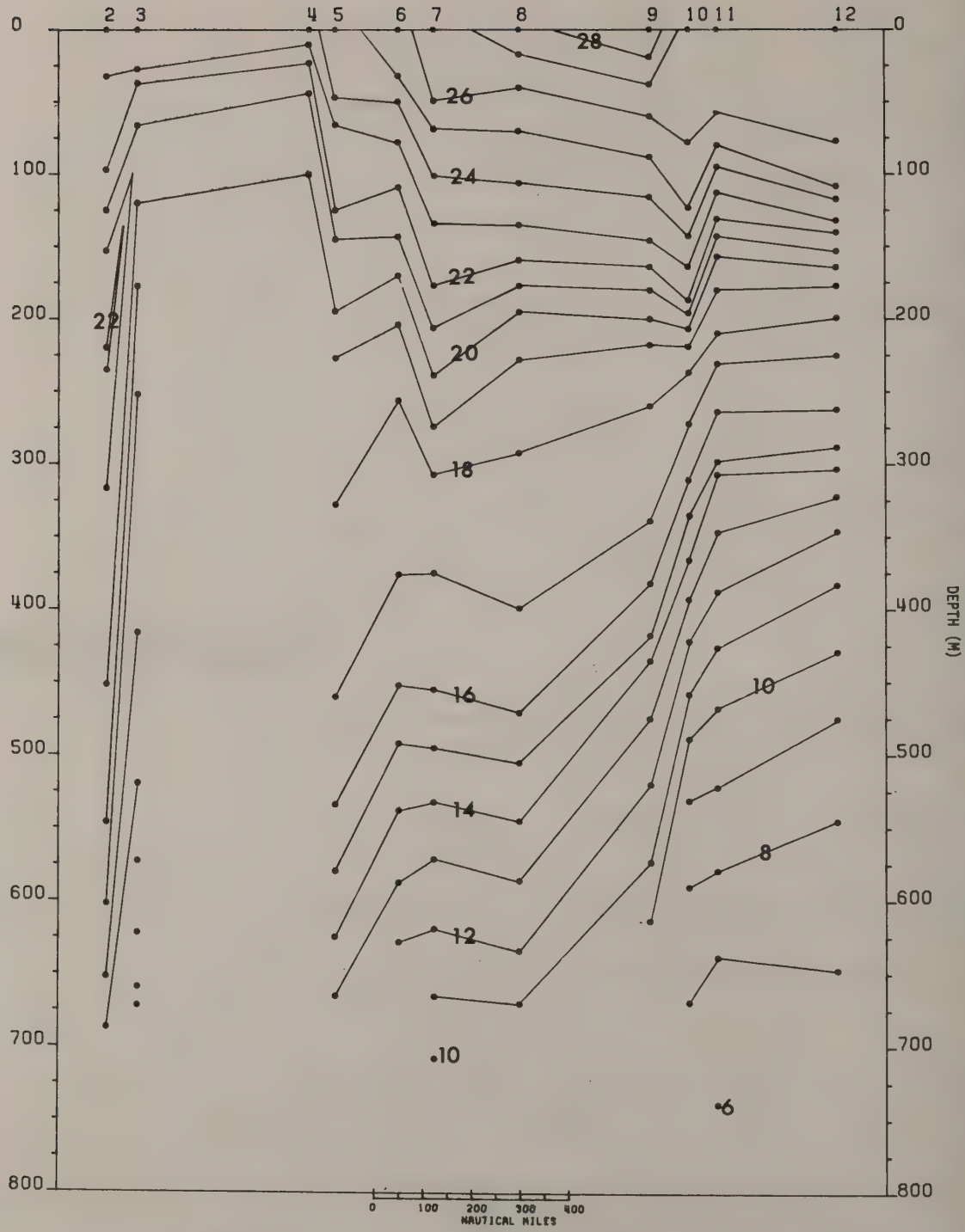


Figure 44.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, 29 May-8 June 1972.

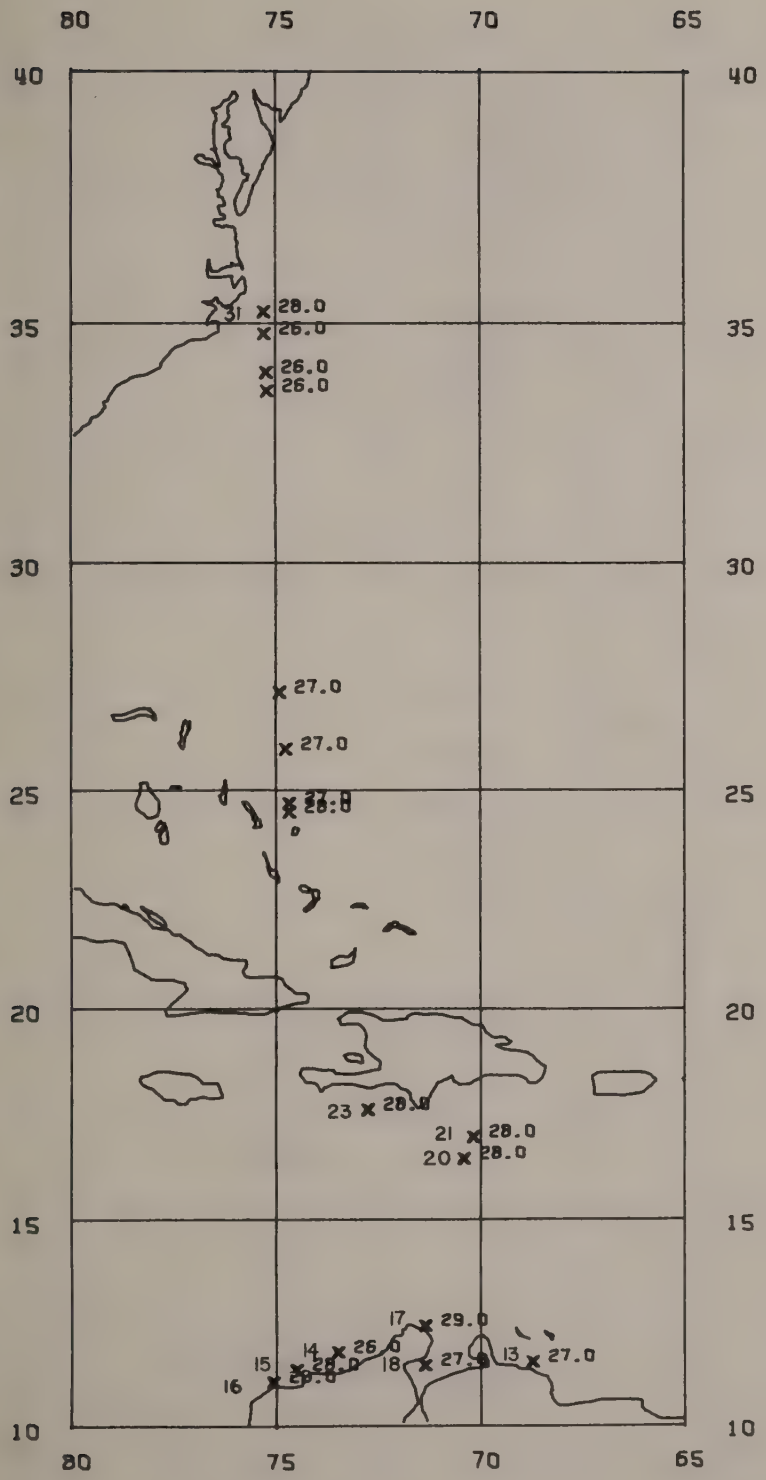


Figure 45.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 8-18 June 1972.

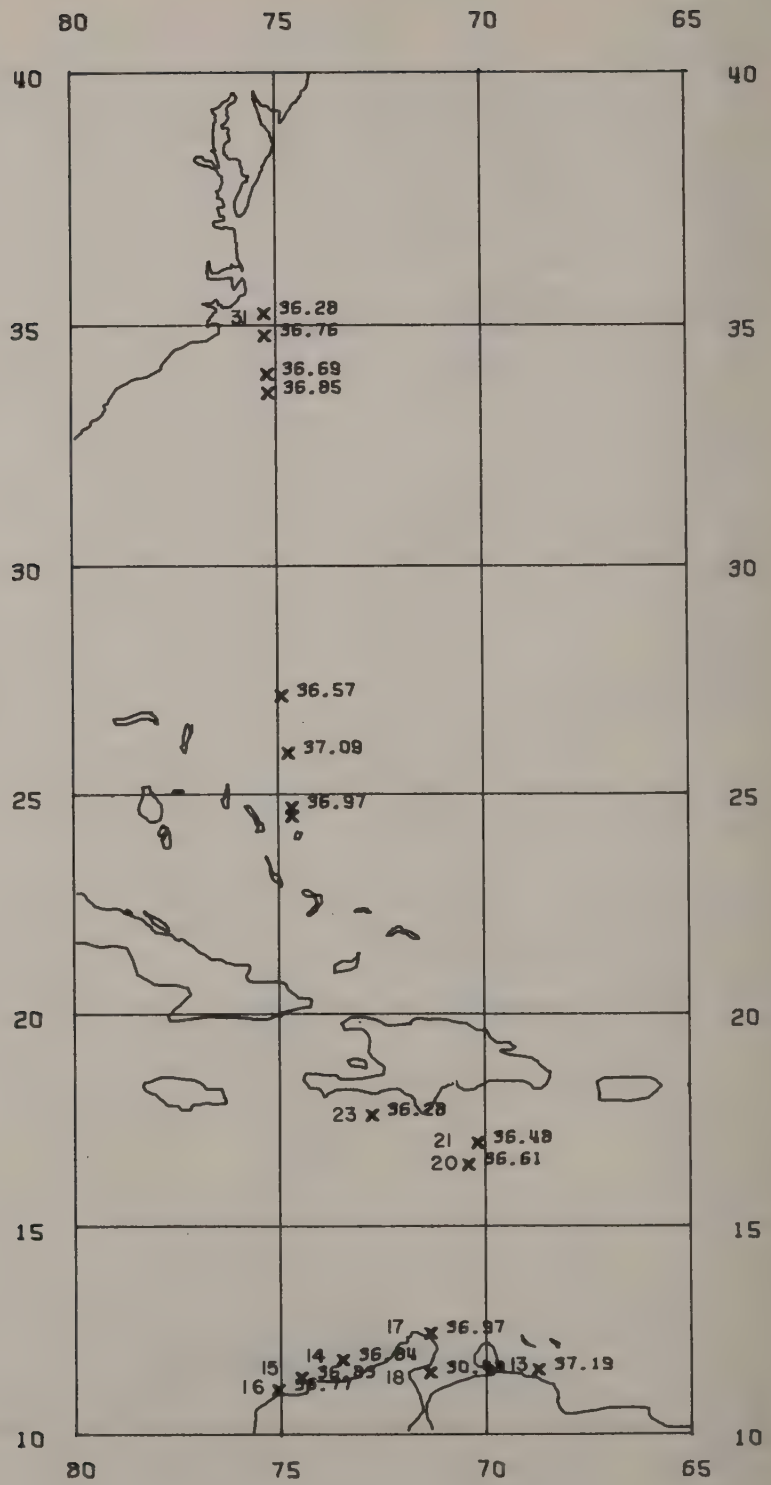


Figure 46.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, **8-18 June 1972.**

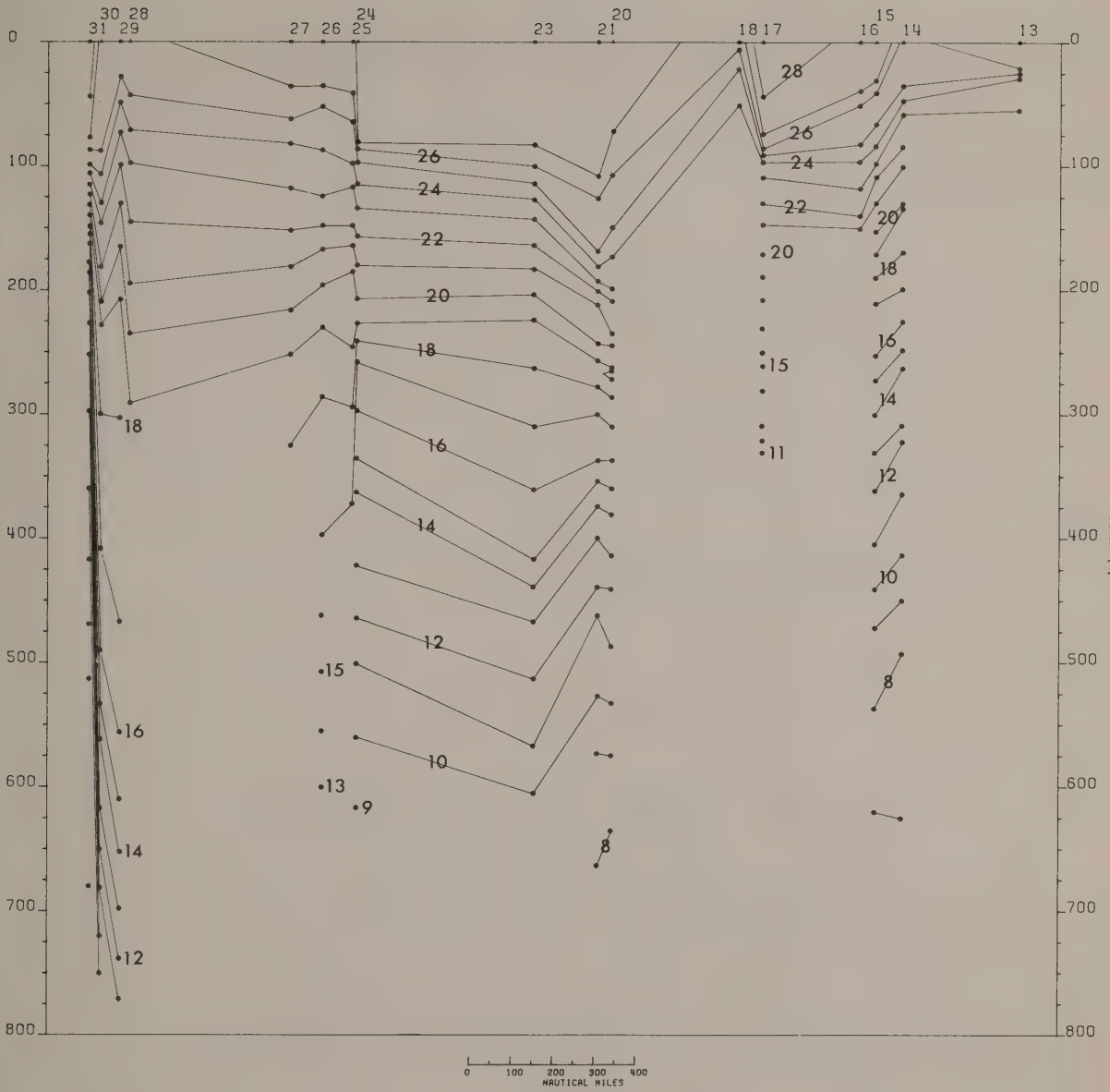


Figure 47.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **8-18 June 1972.**

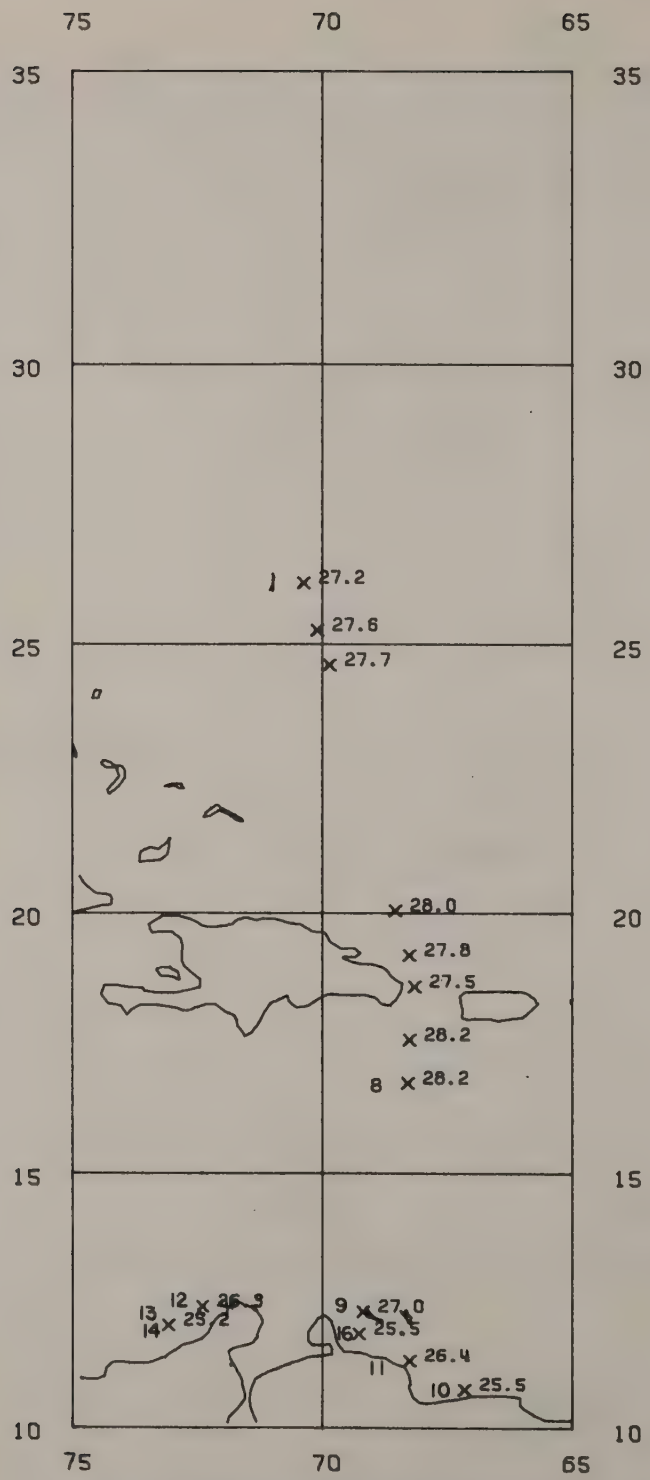


Figure 48.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, **28 June-14 July 1972.**

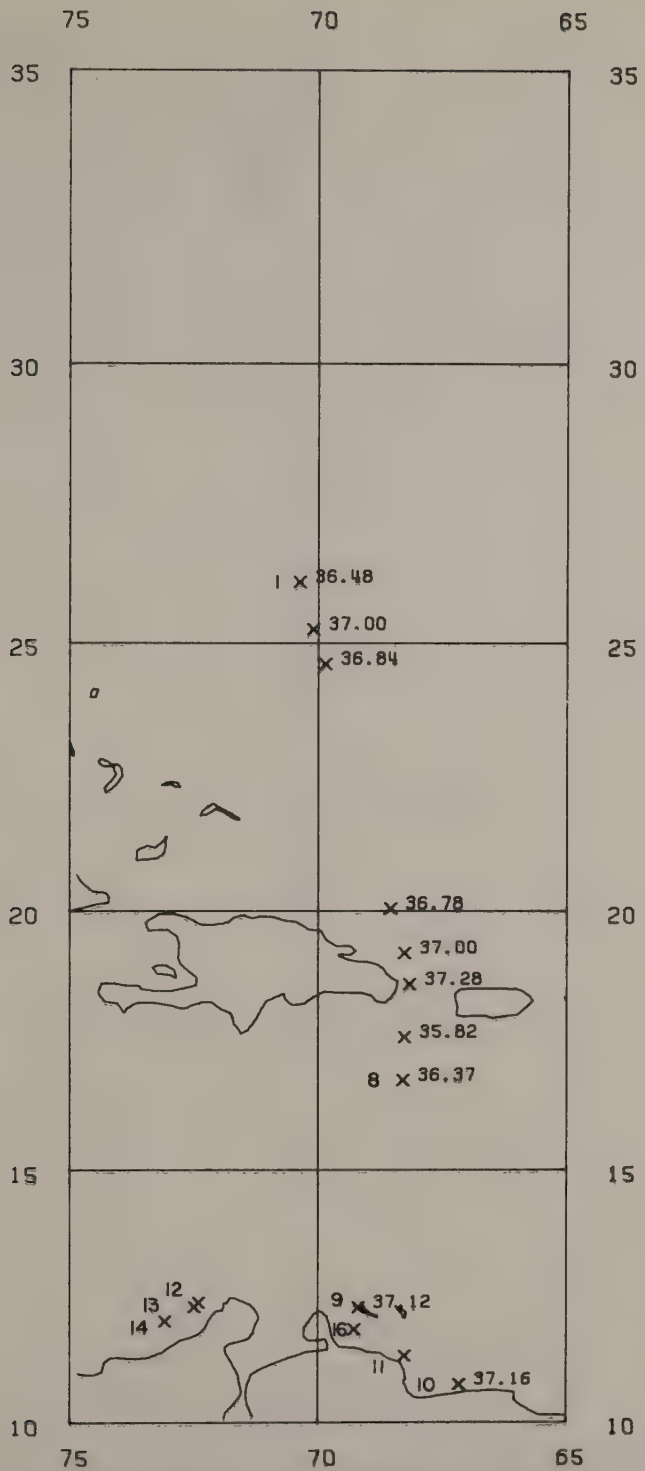


Figure 49.— Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, **28 June-14 July 1972.**

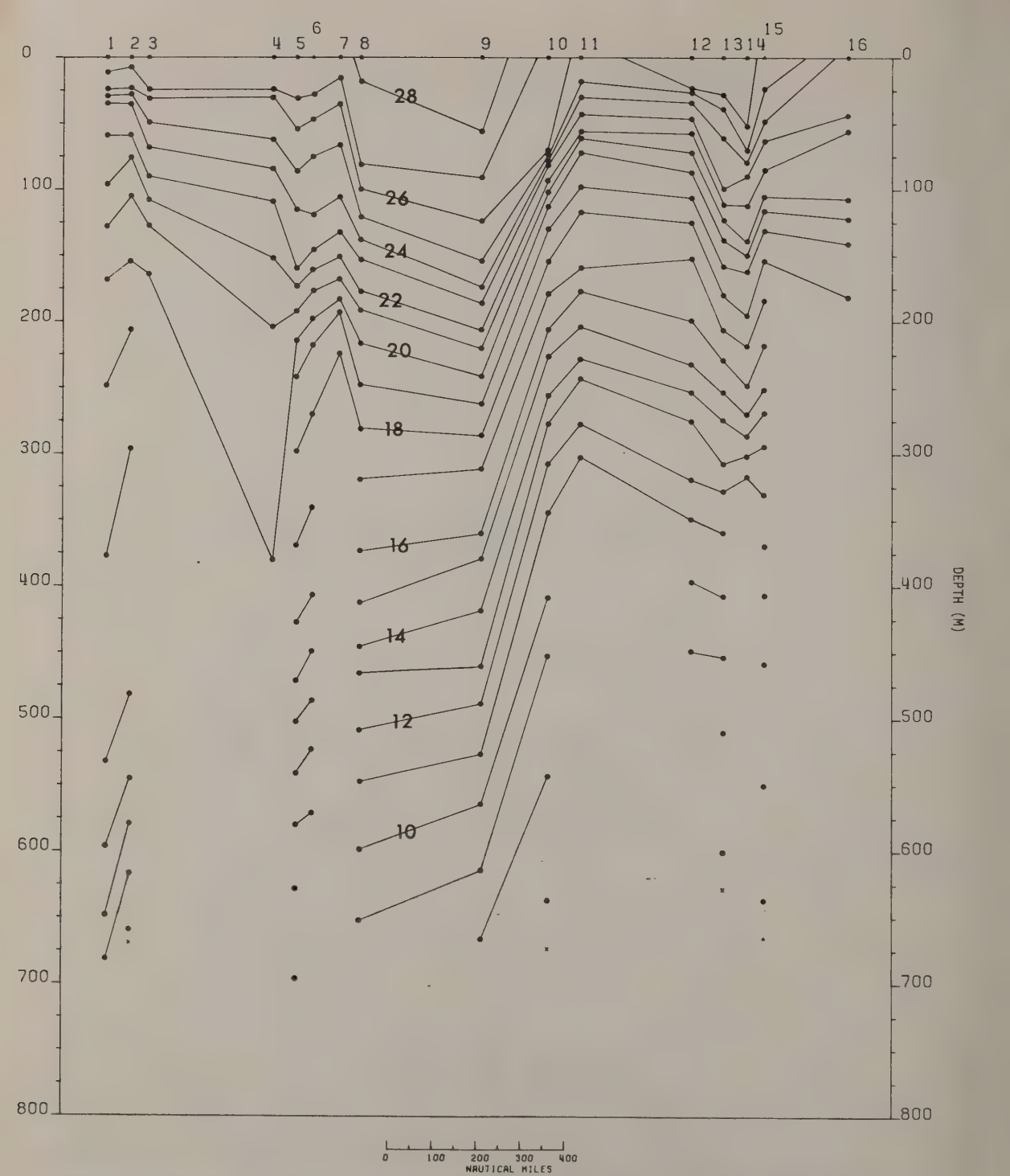


Figure 50.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **28 June-14 July 1972.**

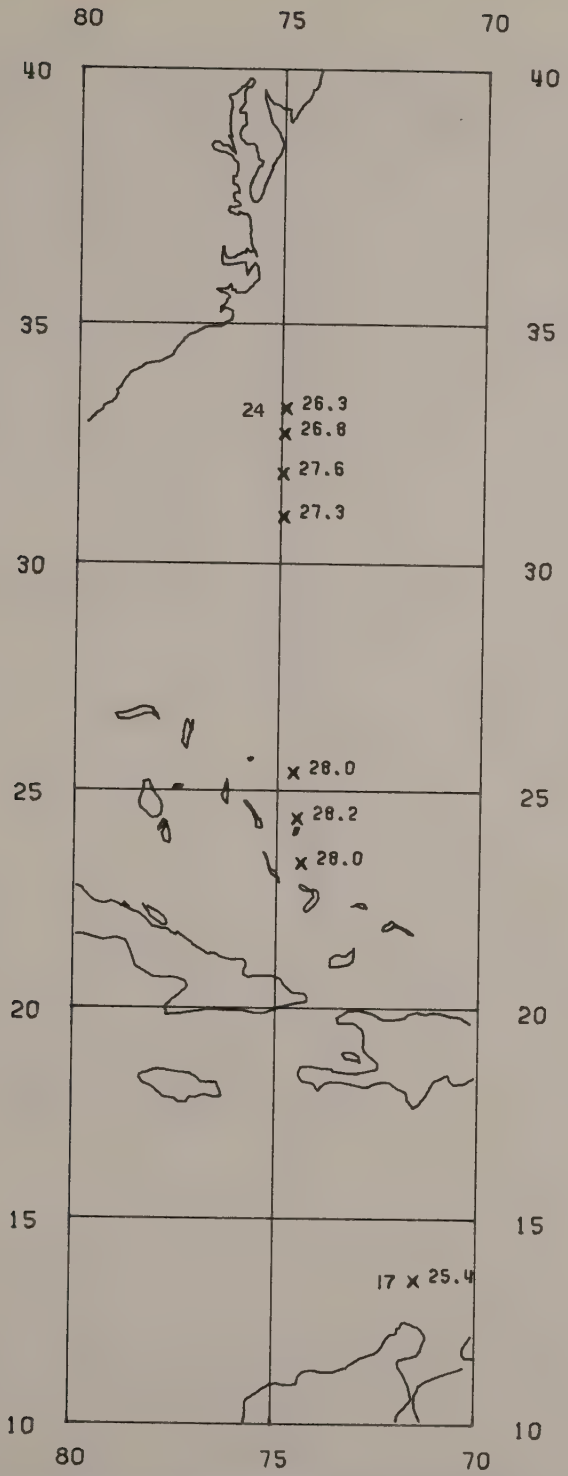


Figure 51.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, **15-18 July 1972.**

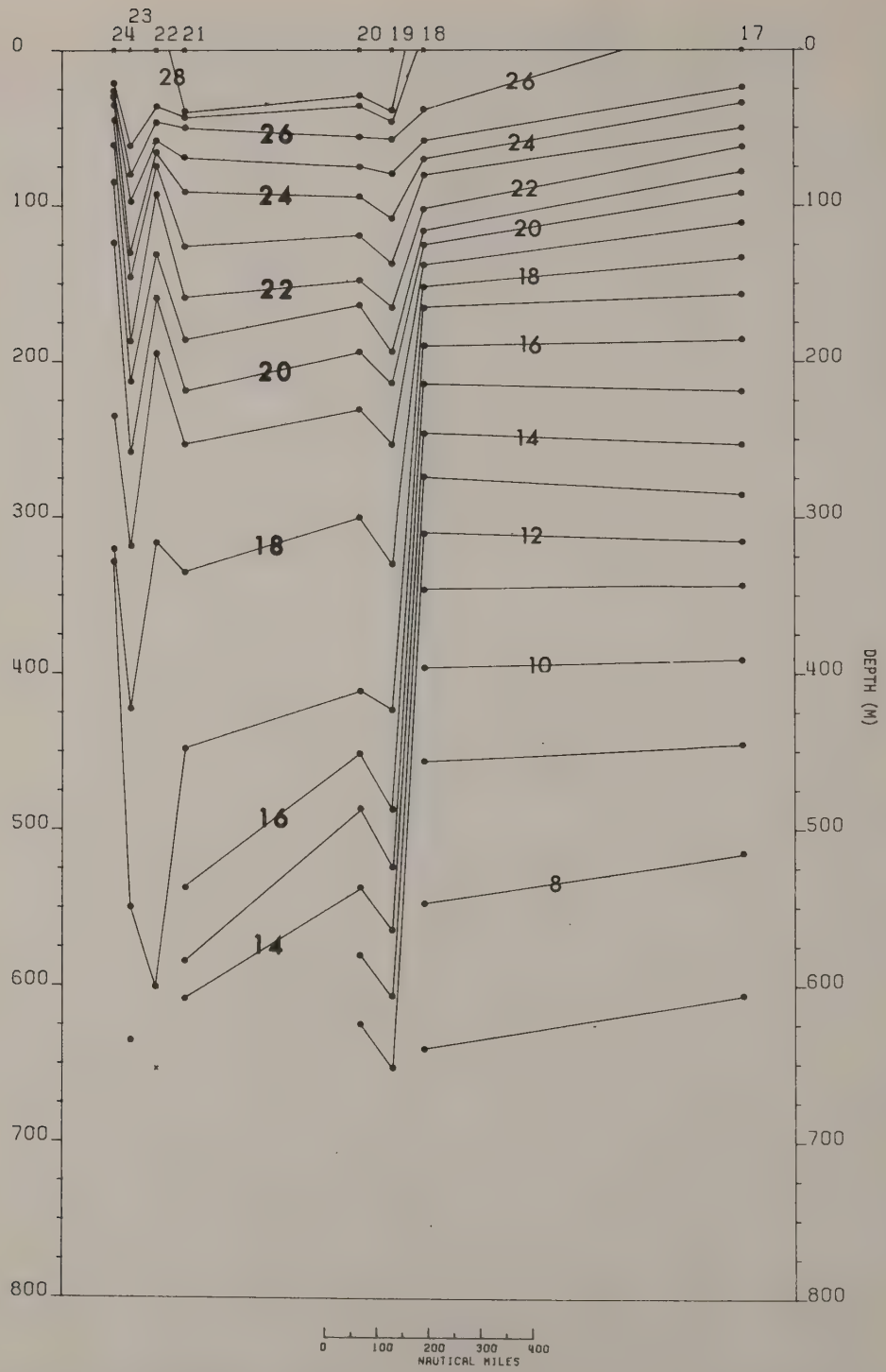


Figure 52.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, 15-18 July 1972.

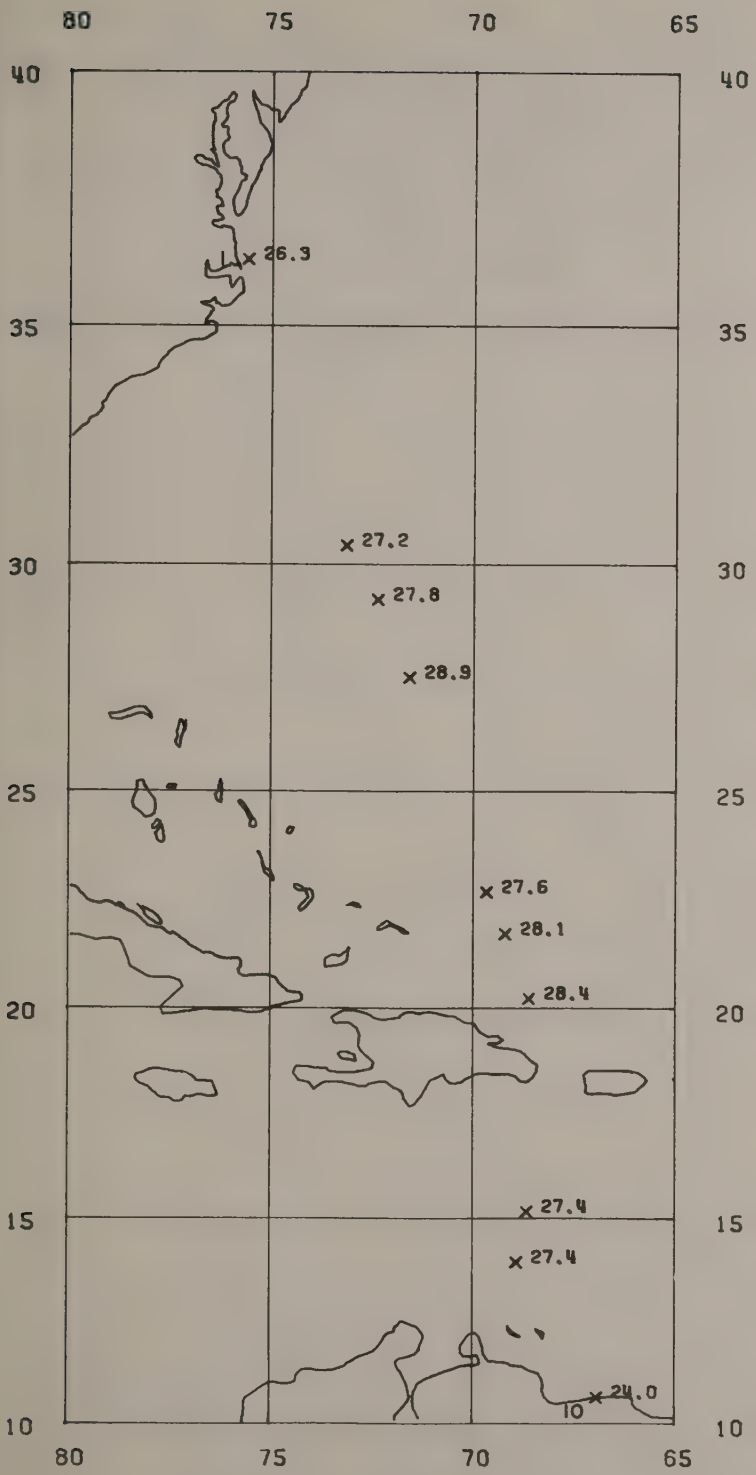


Figure 53.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 25-31 July 1972.

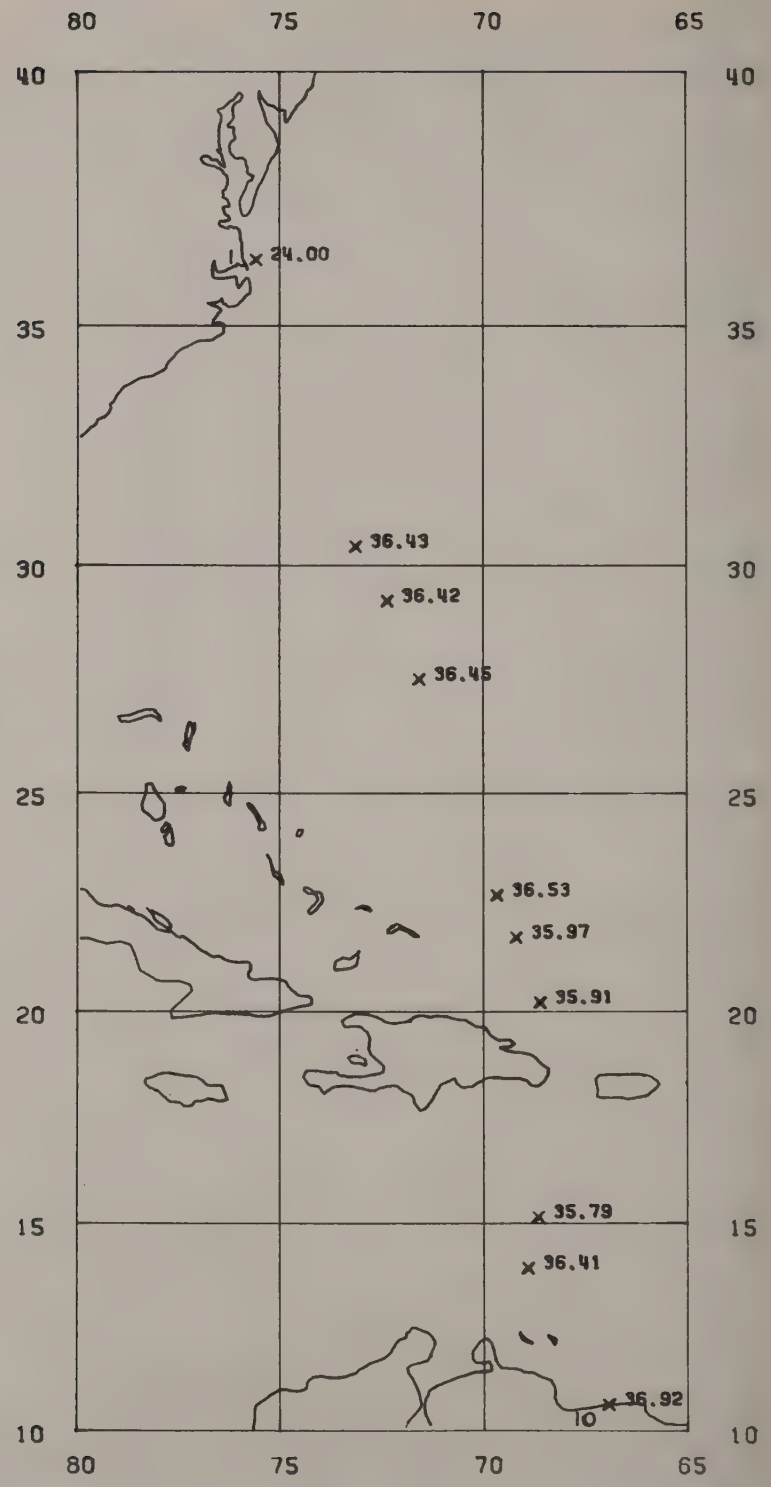


Figure 54.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, 25-31 July 1972.

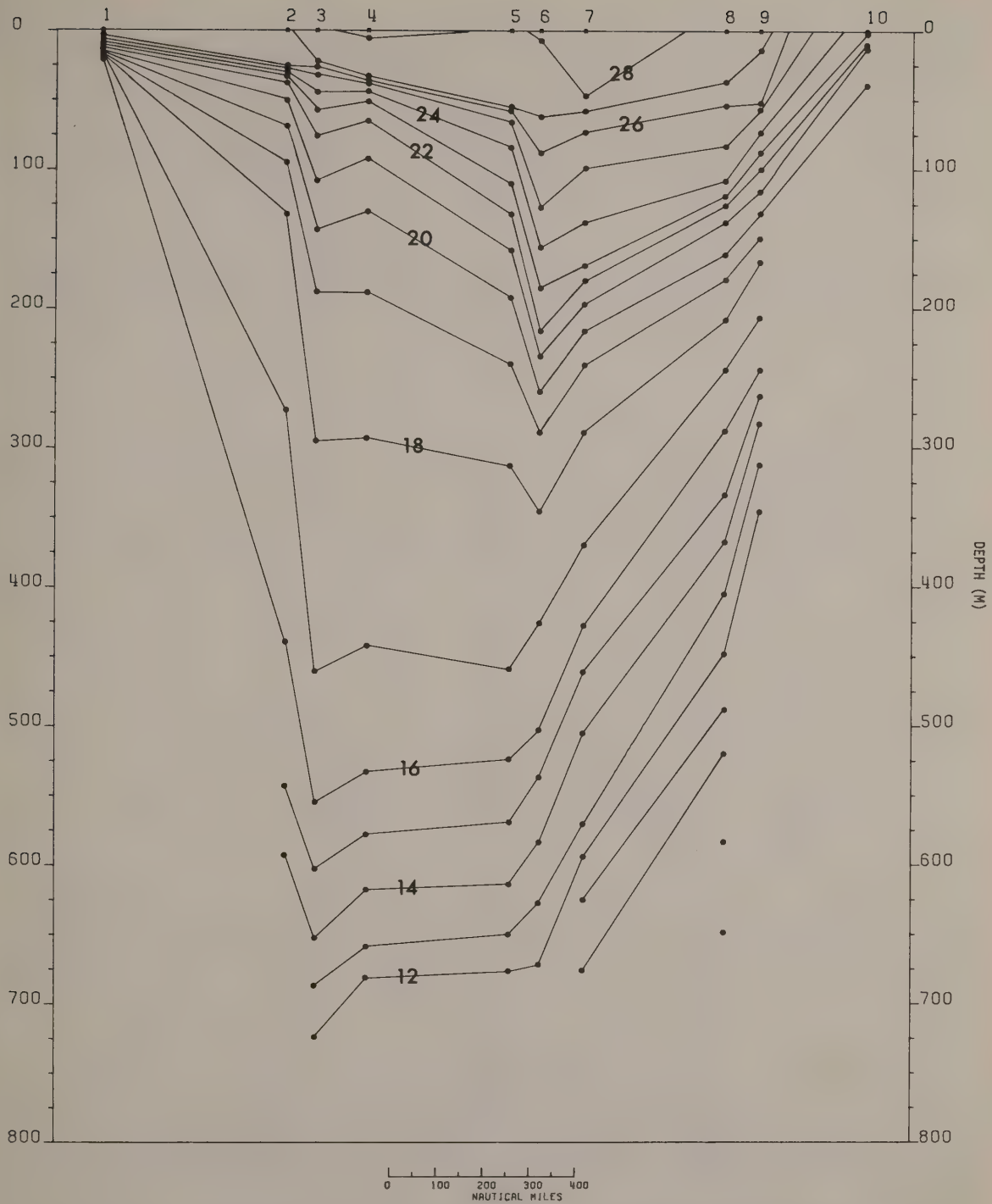


Figure 55.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **25-31 July 1972.**

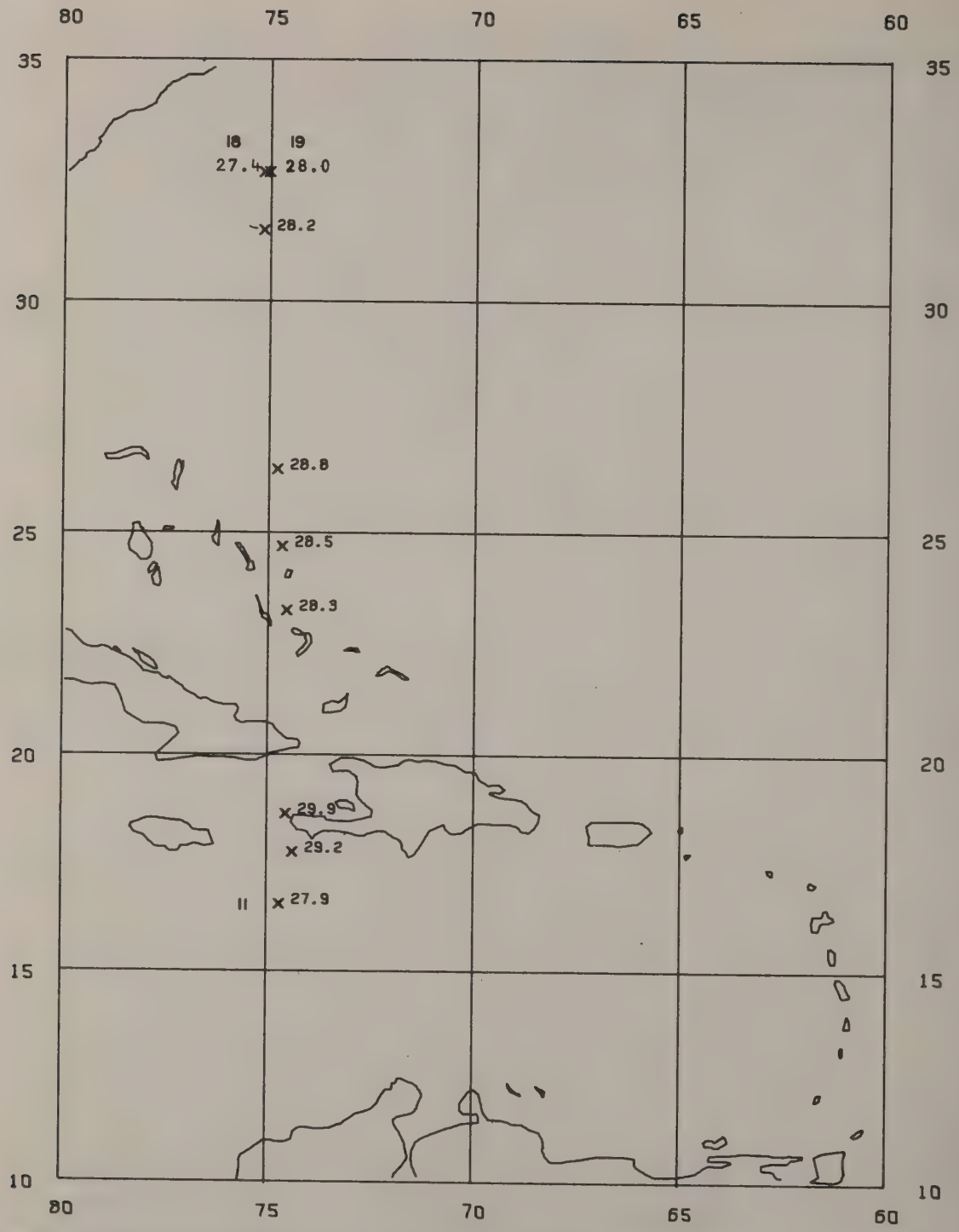


Figure 56.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 11-14 August 1972.

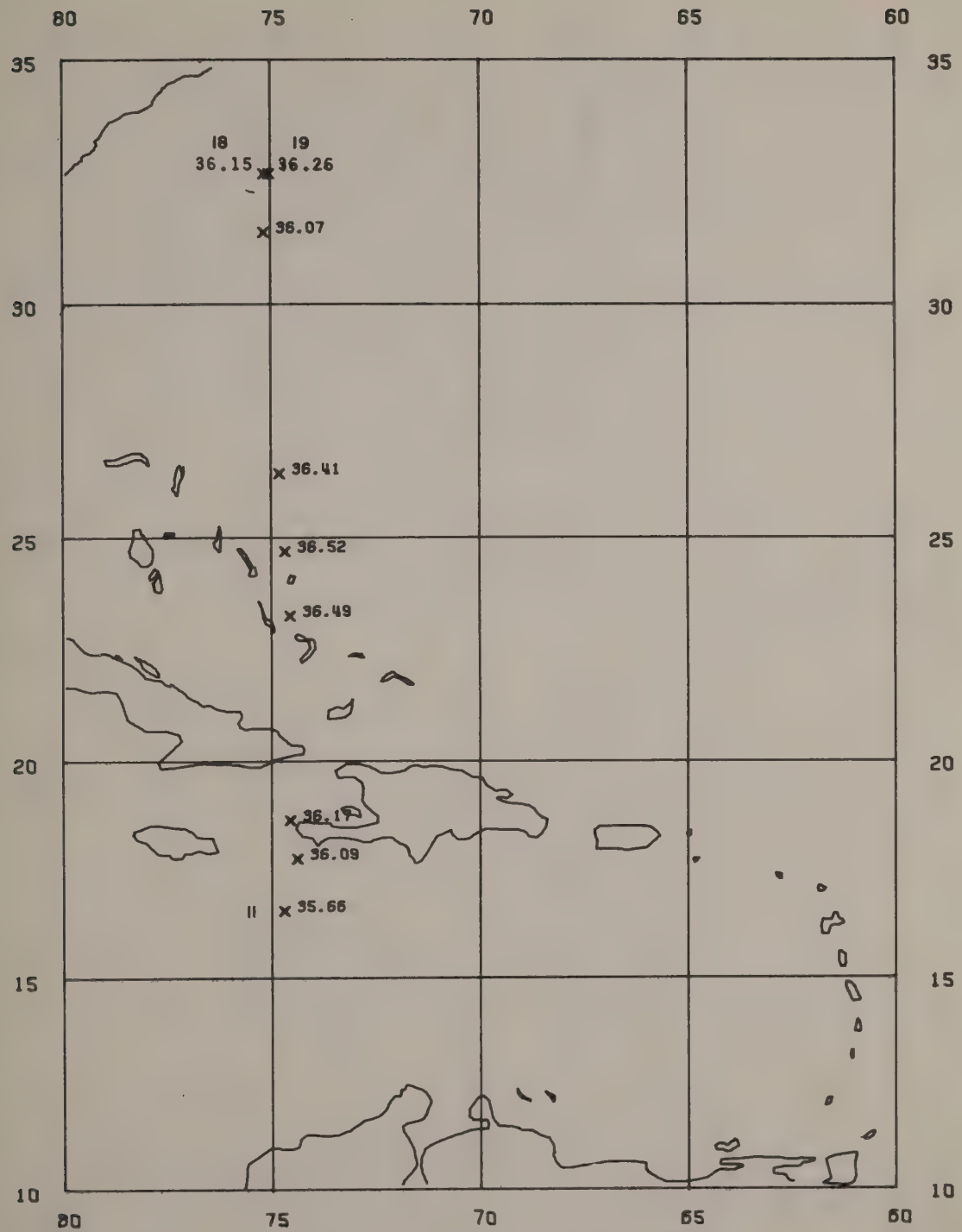


Figure 57.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, 11-14 August 1972.

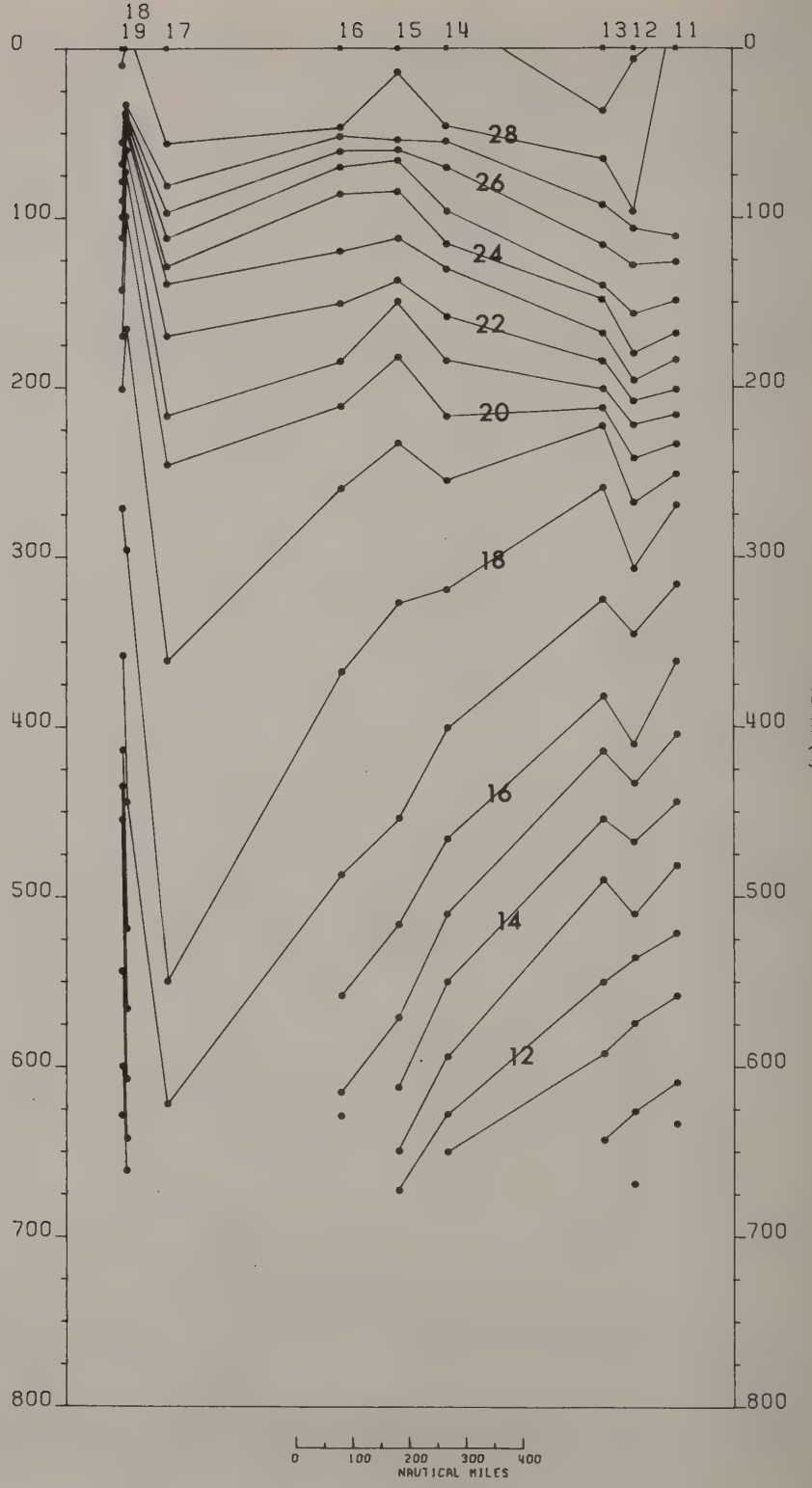


Figure 58.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **11-14 August 1972.**

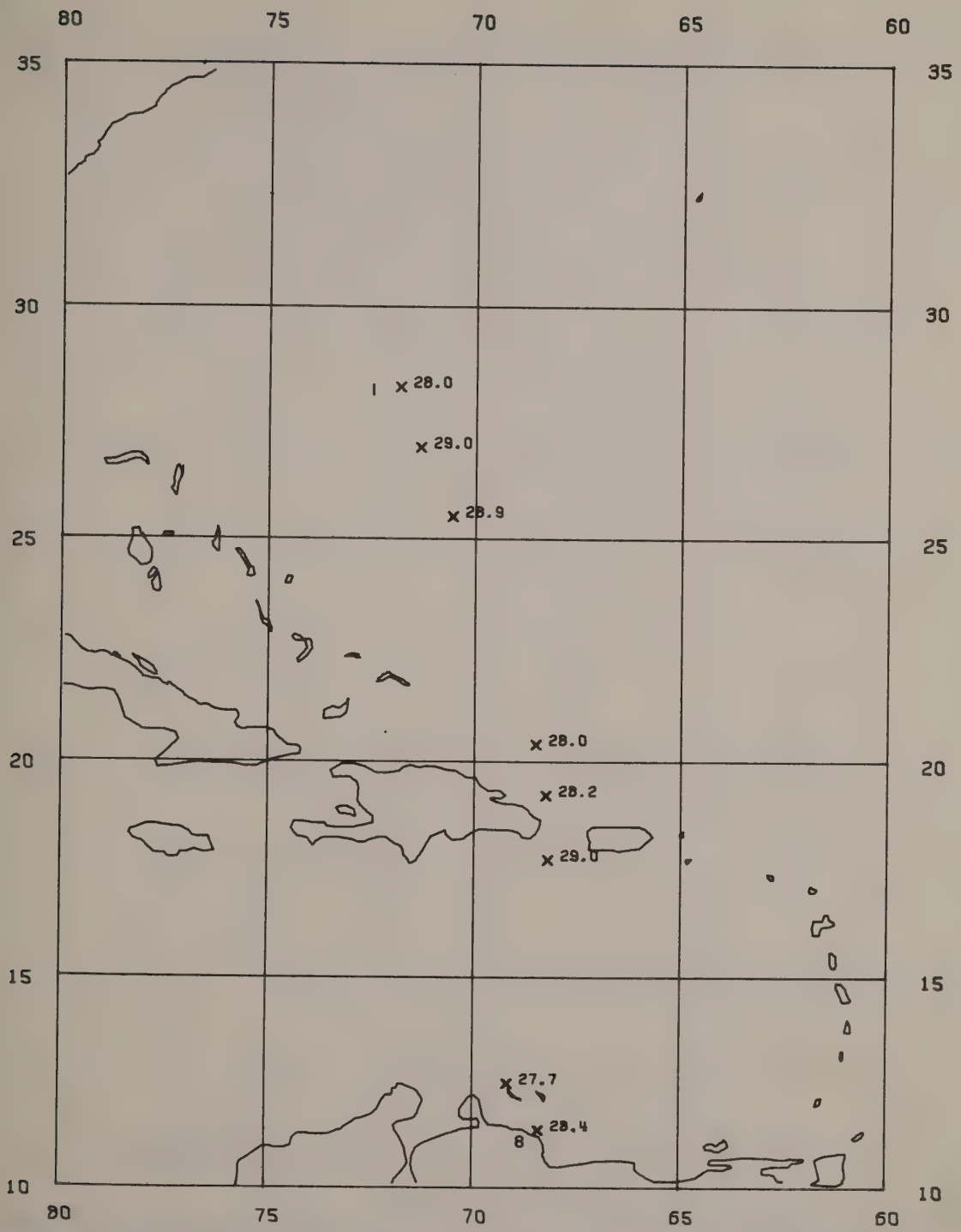


Figure 59.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 21 August-1 September 1972.

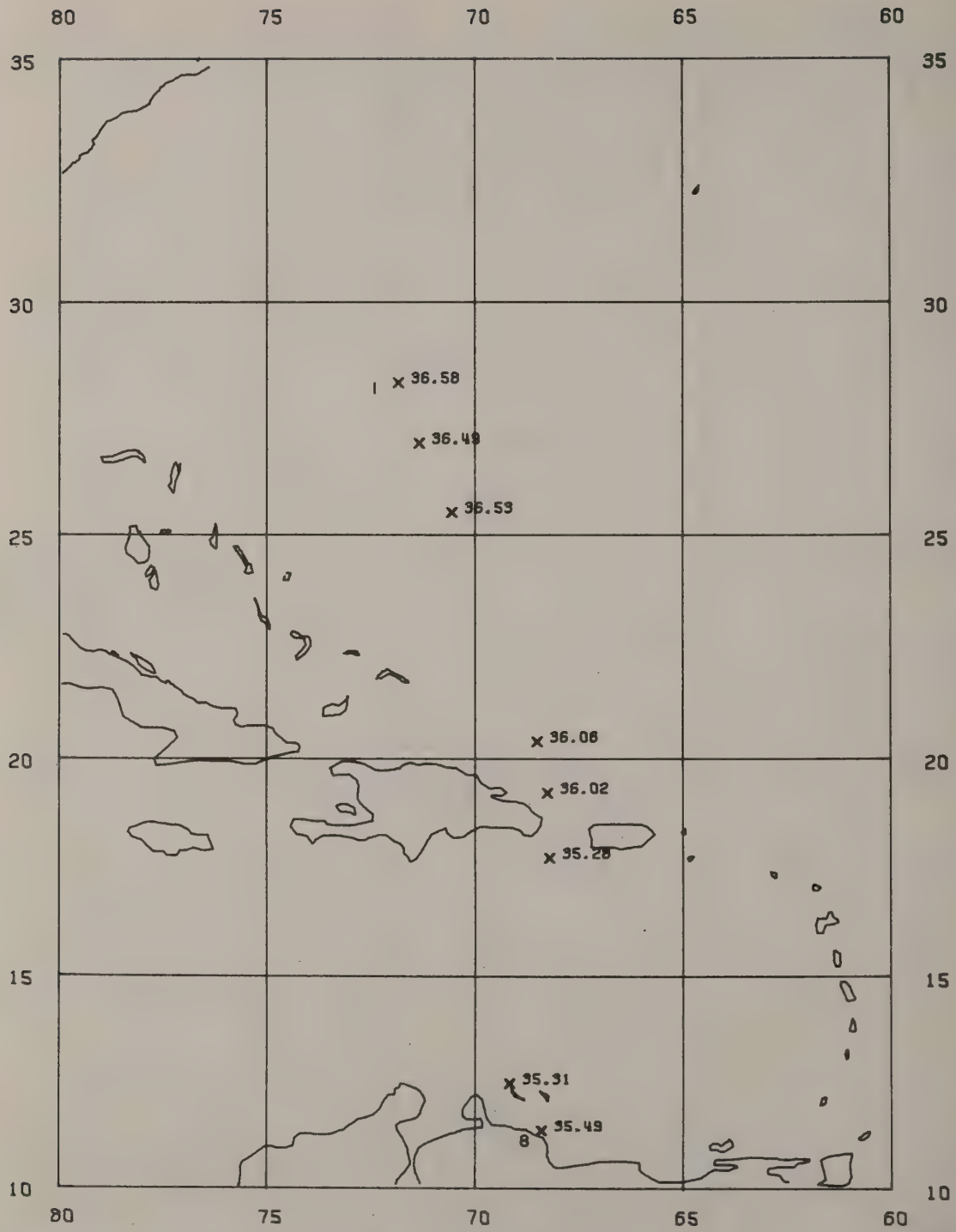


Figure 60.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, 21 August-1 September 1972.

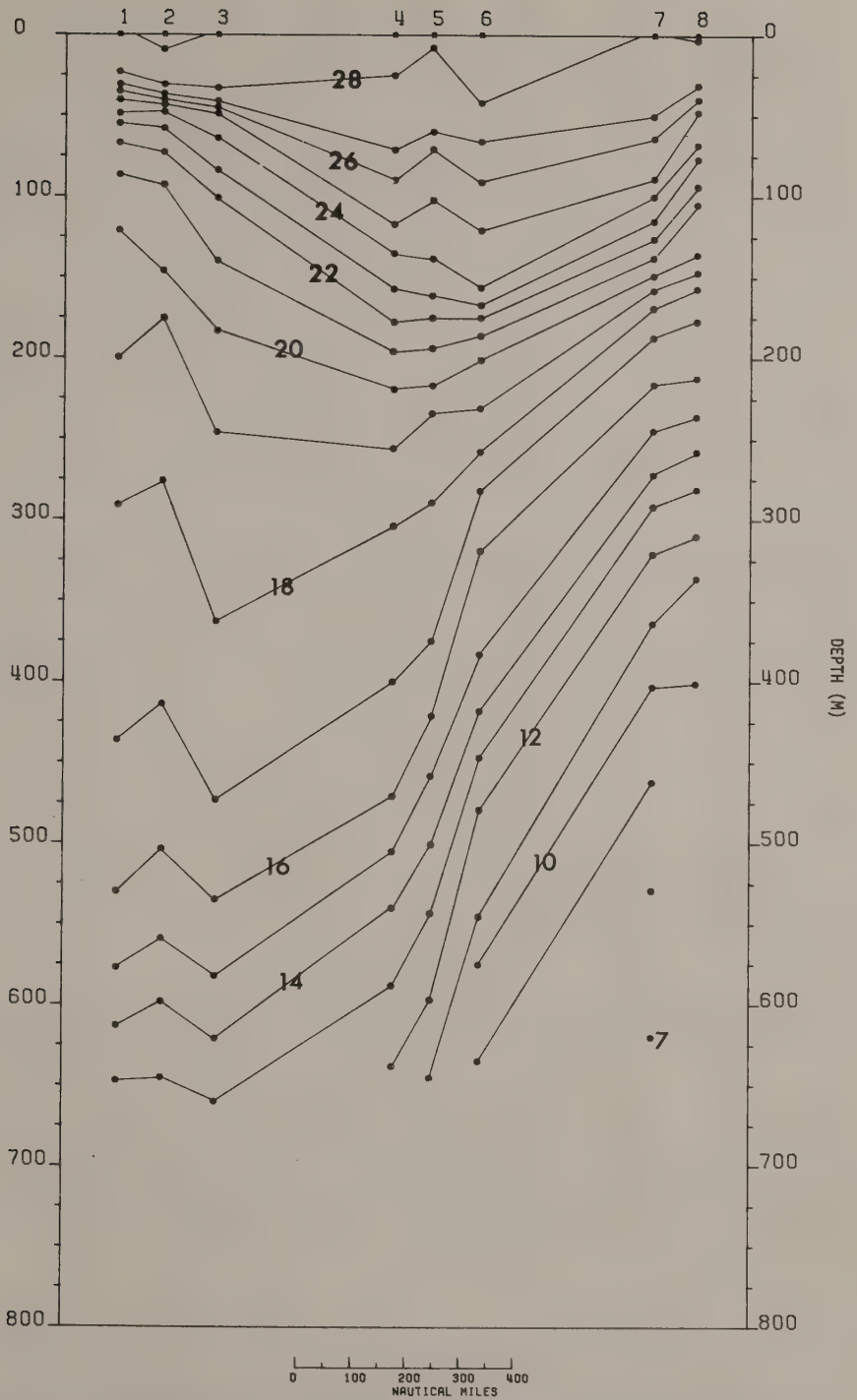


Figure 61.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **21 August-1 September 1972.**

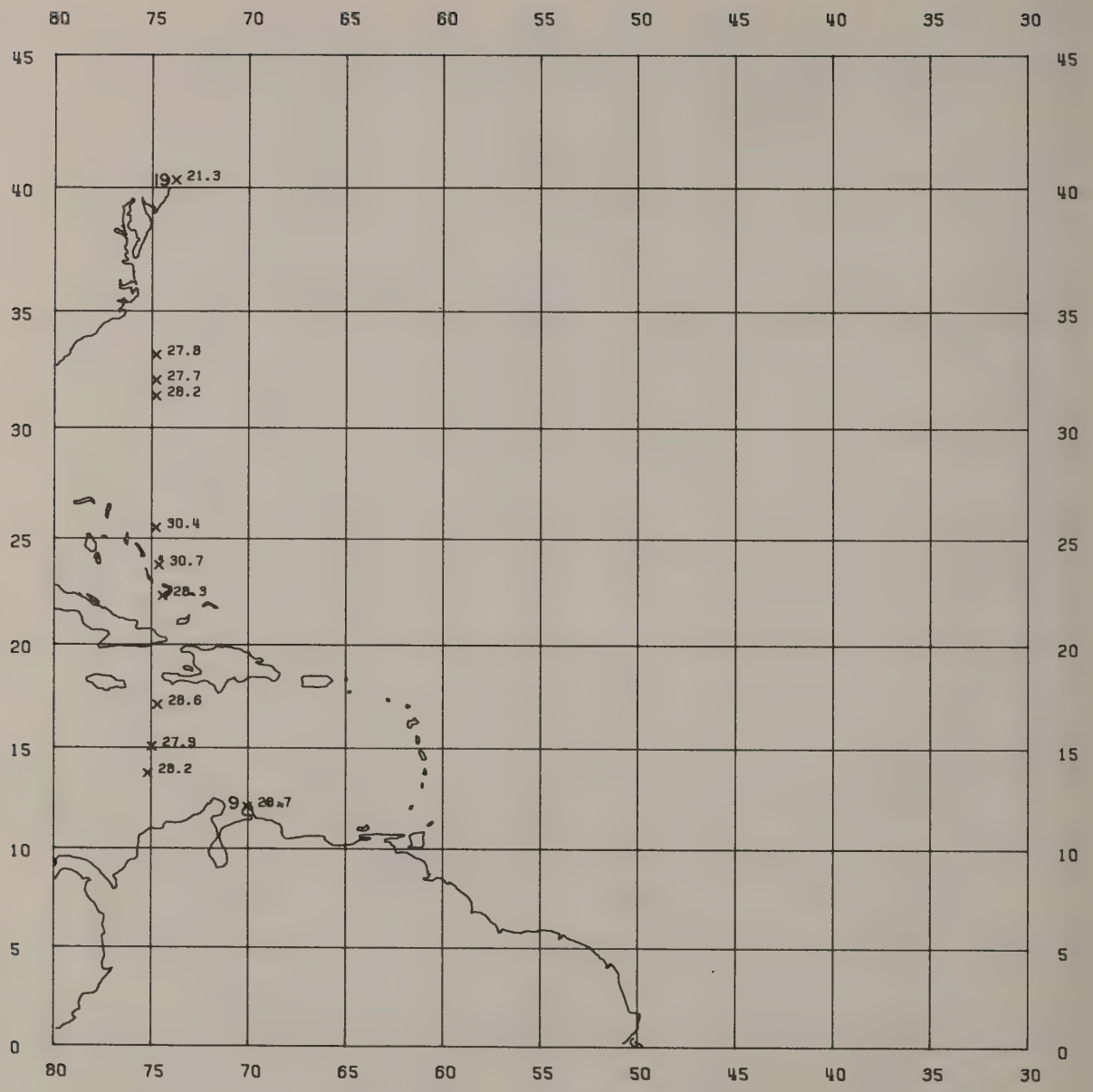


Figure 62.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz,* **2-13 September 1972.**

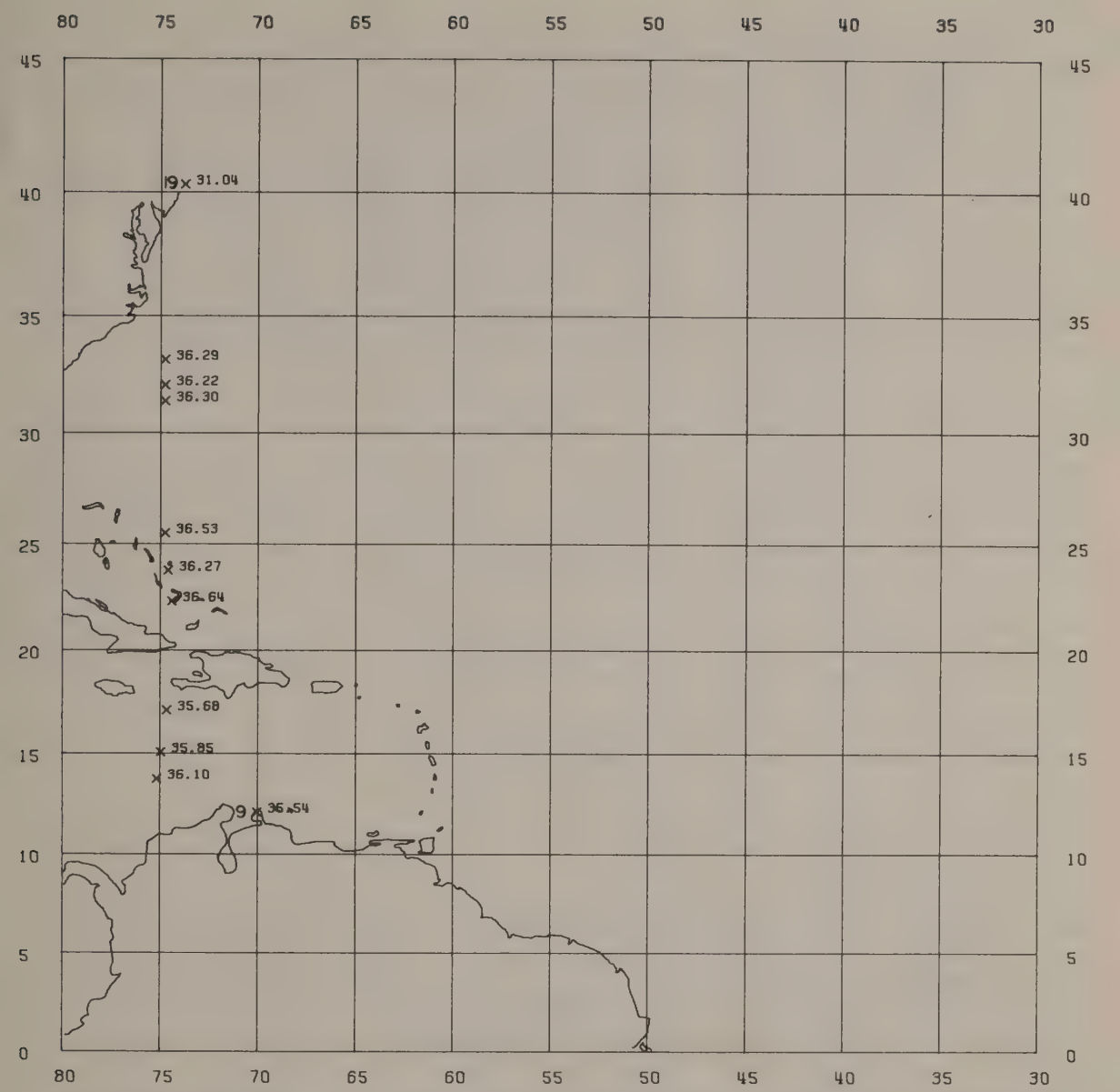


Figure 63.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, **2-13 September 1972.**

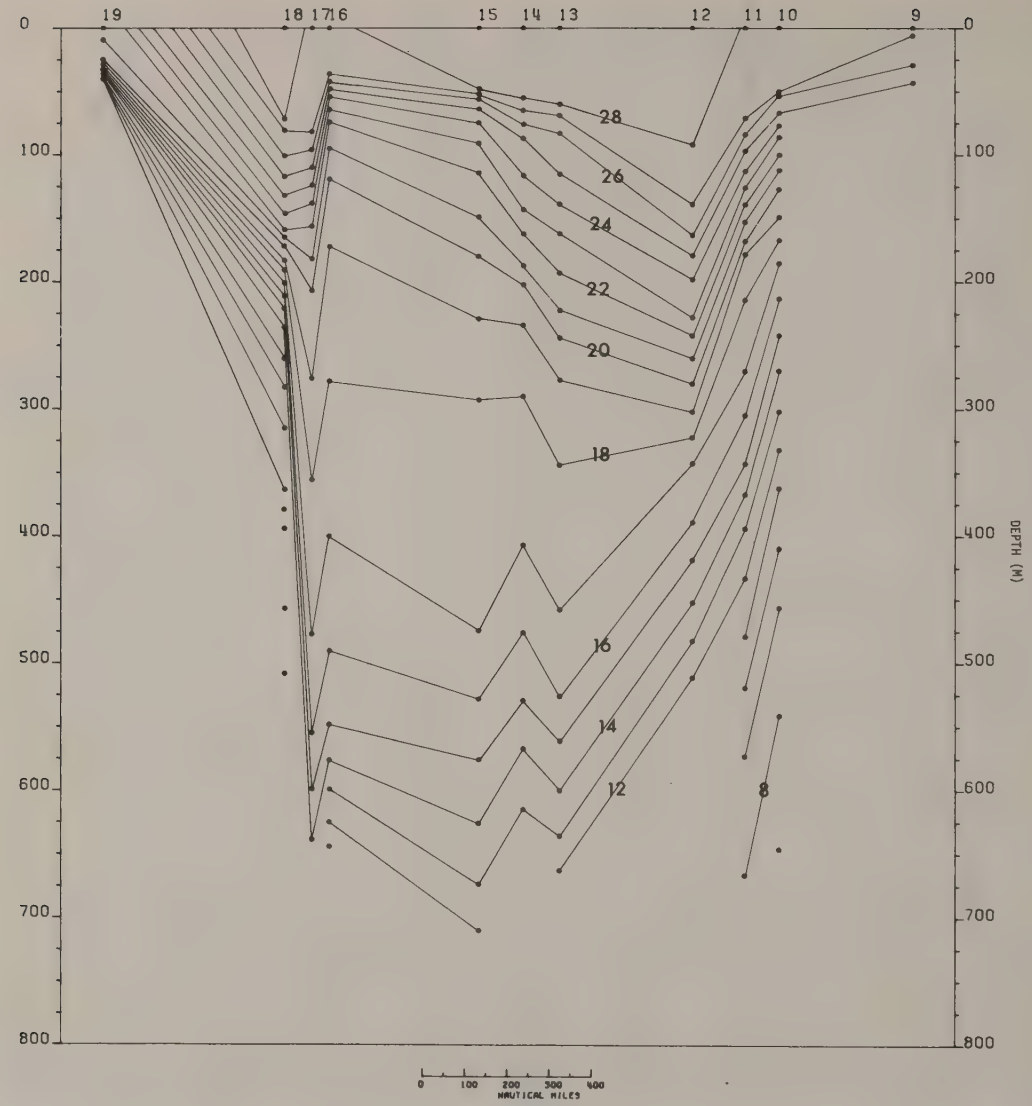


Figure 64.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **2-13 September 1972.**

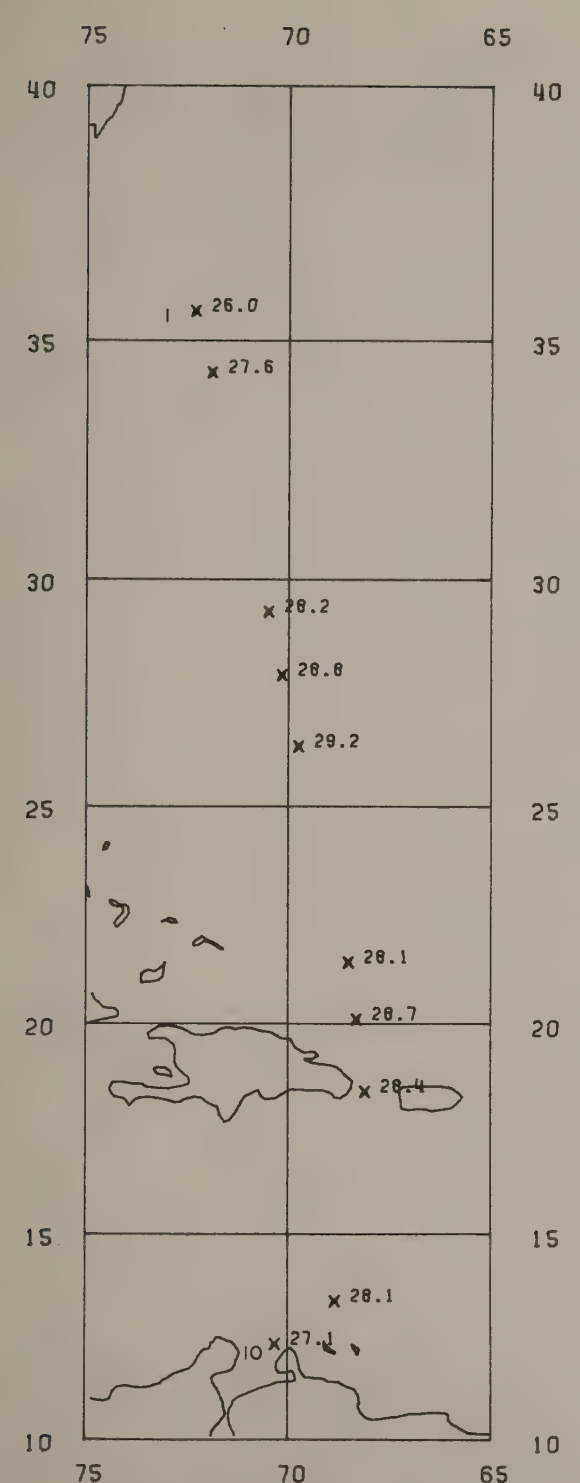


Figure 65.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 17-30 September 1972.

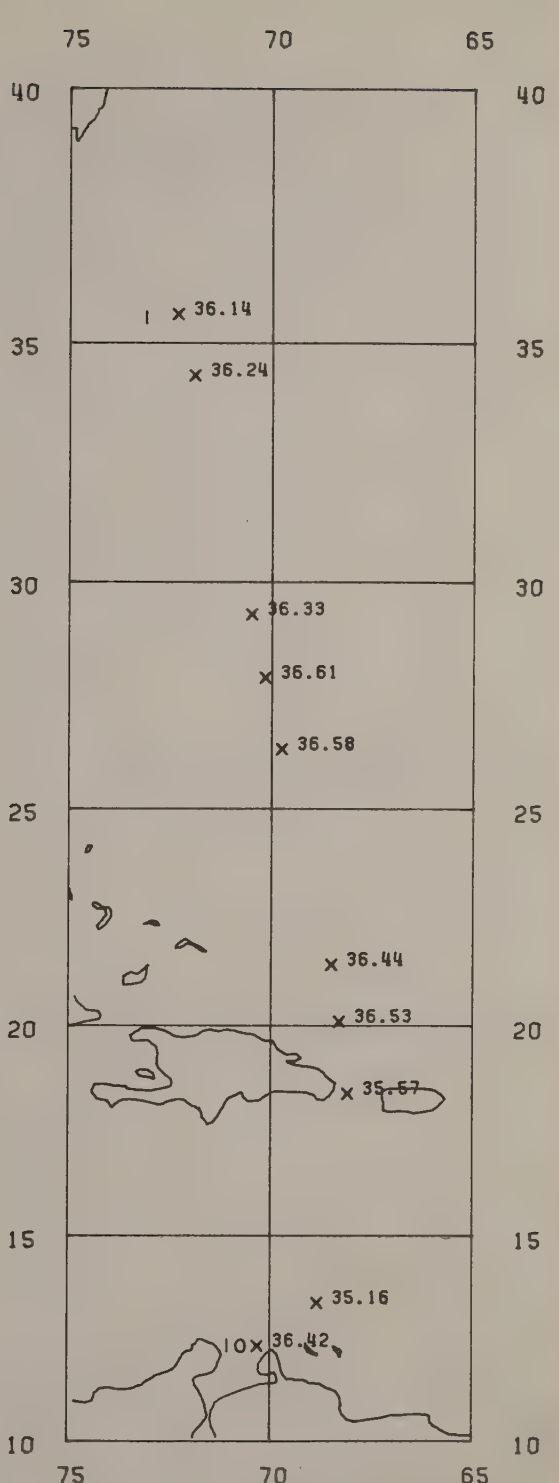


Figure 66.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, 17-30 September 1972.

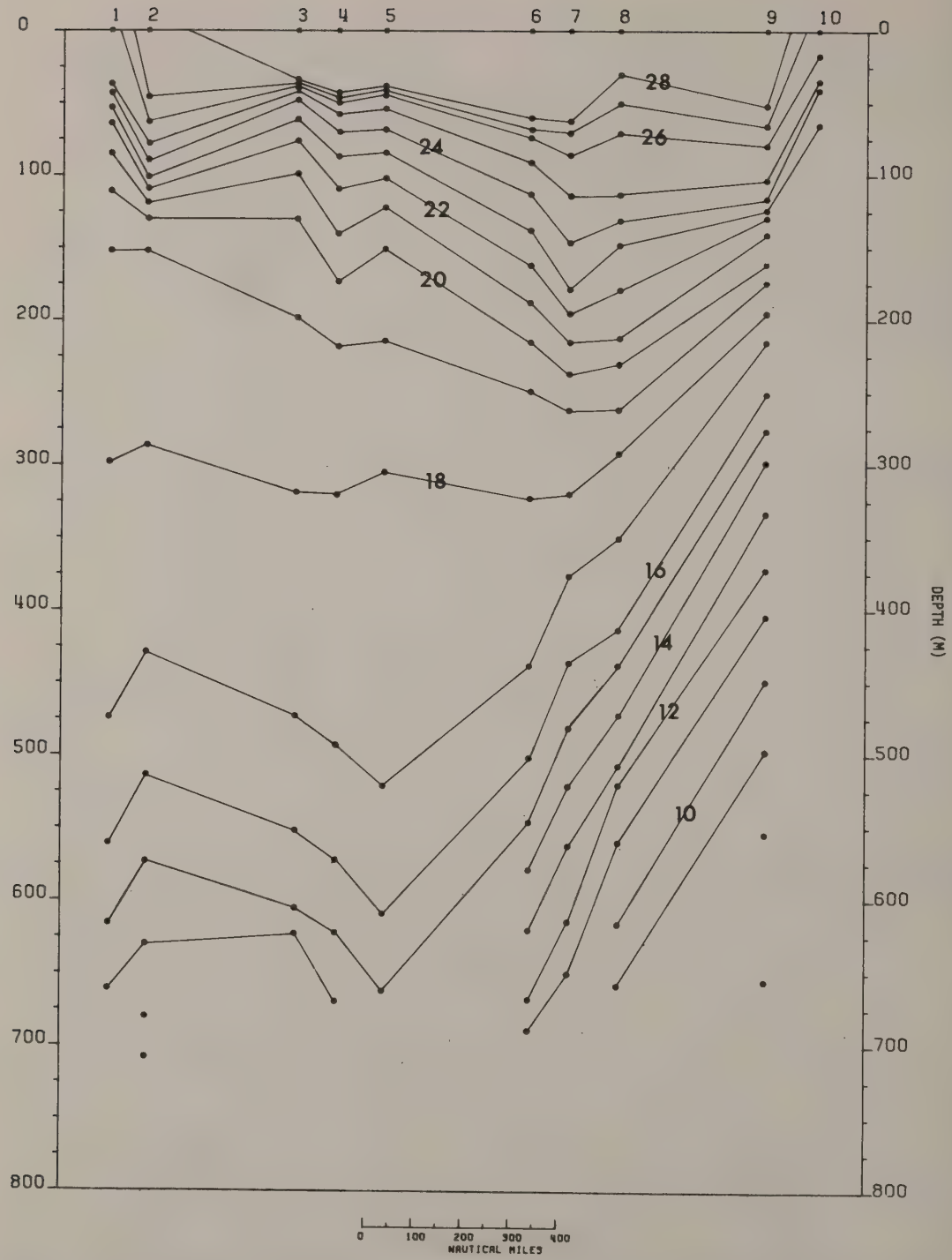


Figure 67.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **17-30 September 1972.**

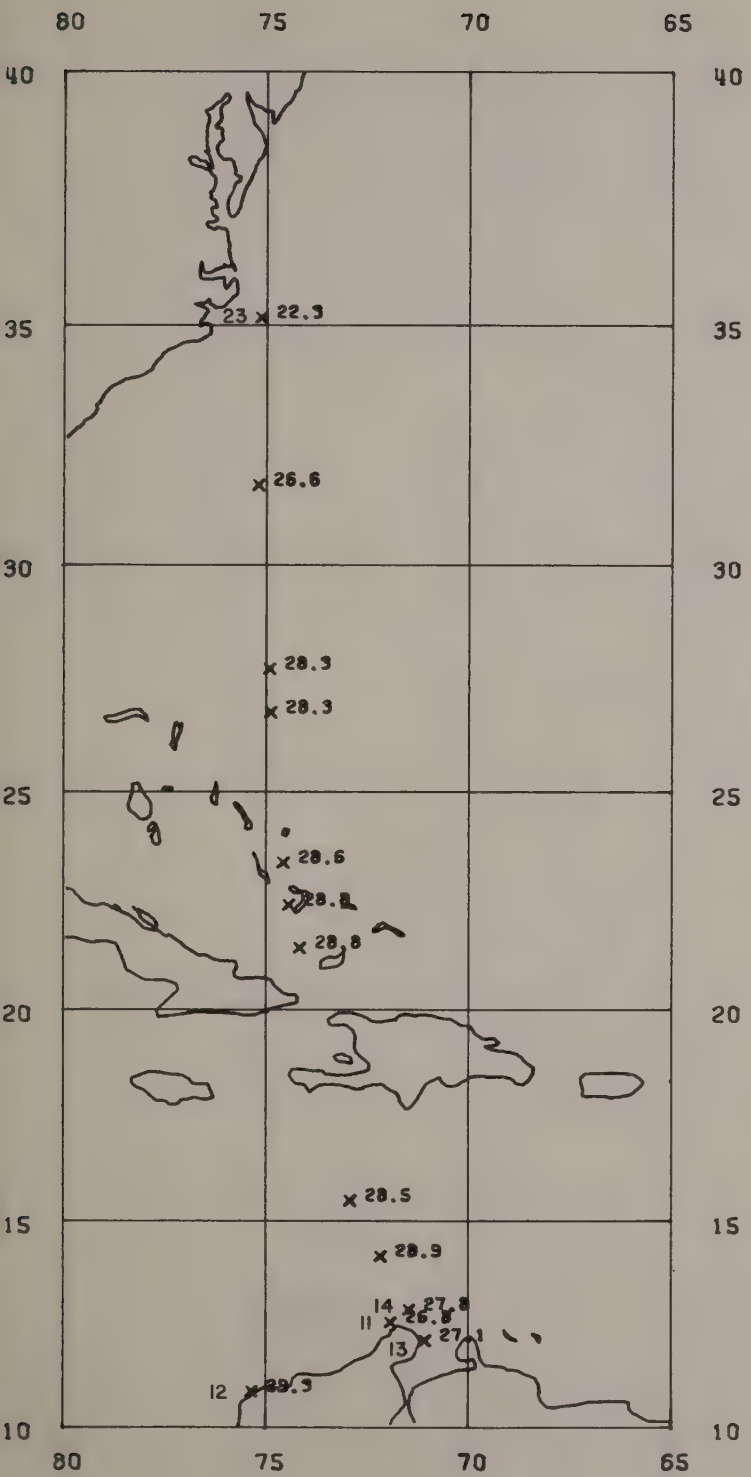


Figure 68.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, 30 September-9 October 1972.

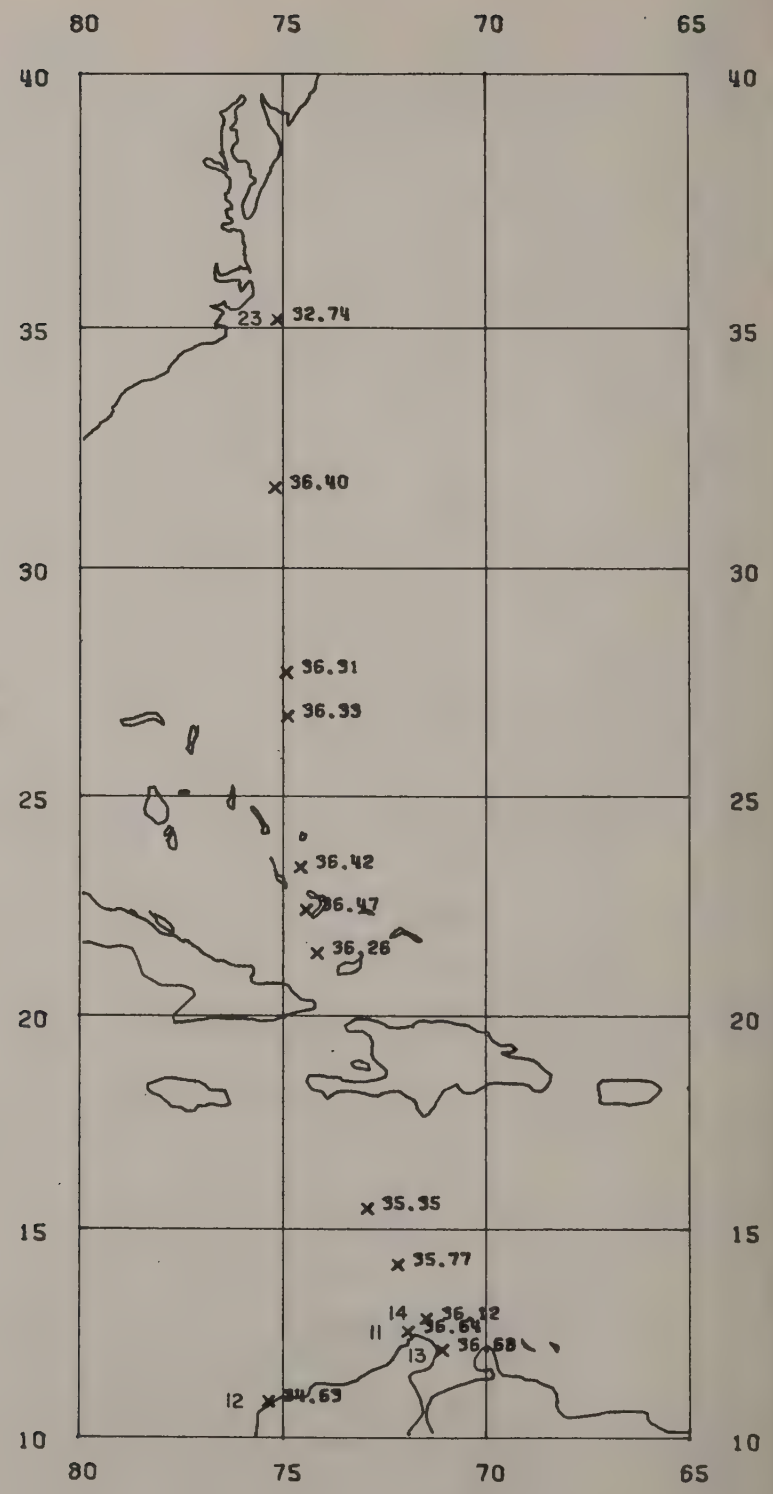


Figure 69.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz,* **30 September-9 October 1972.**

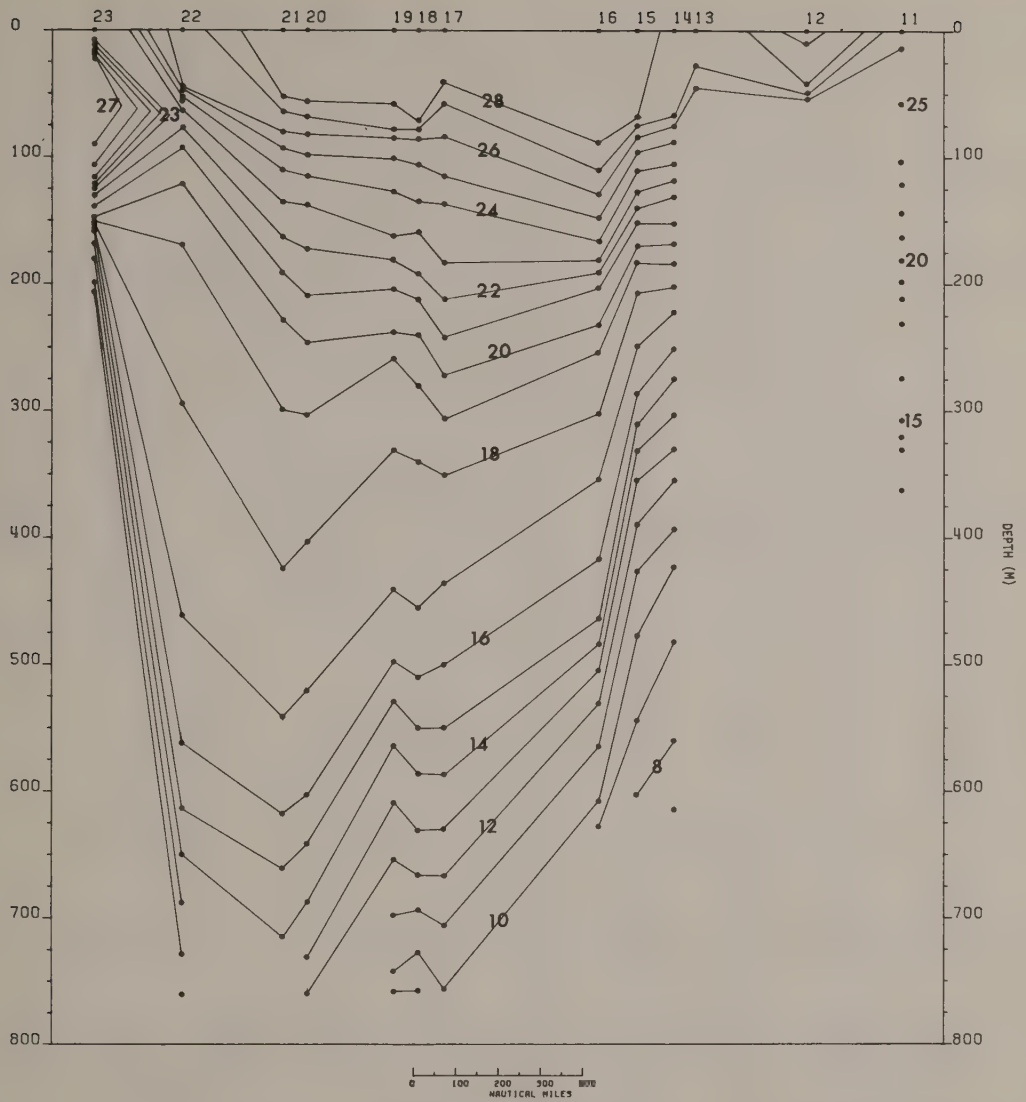


Figure 70.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **30 September-9 October 1972.**

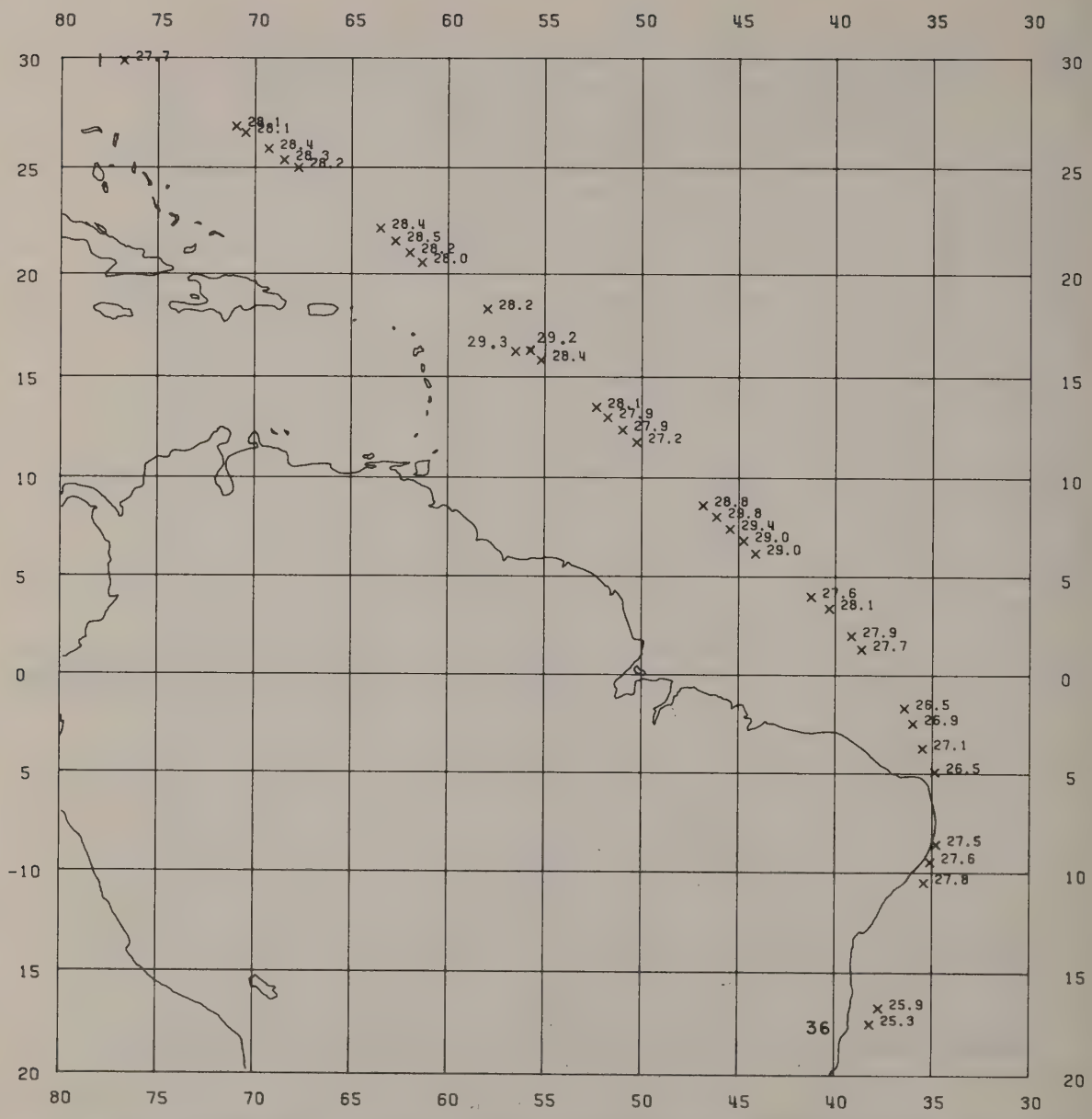


Figure 71.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Mormac Pride*, **4-13 October 1972.**

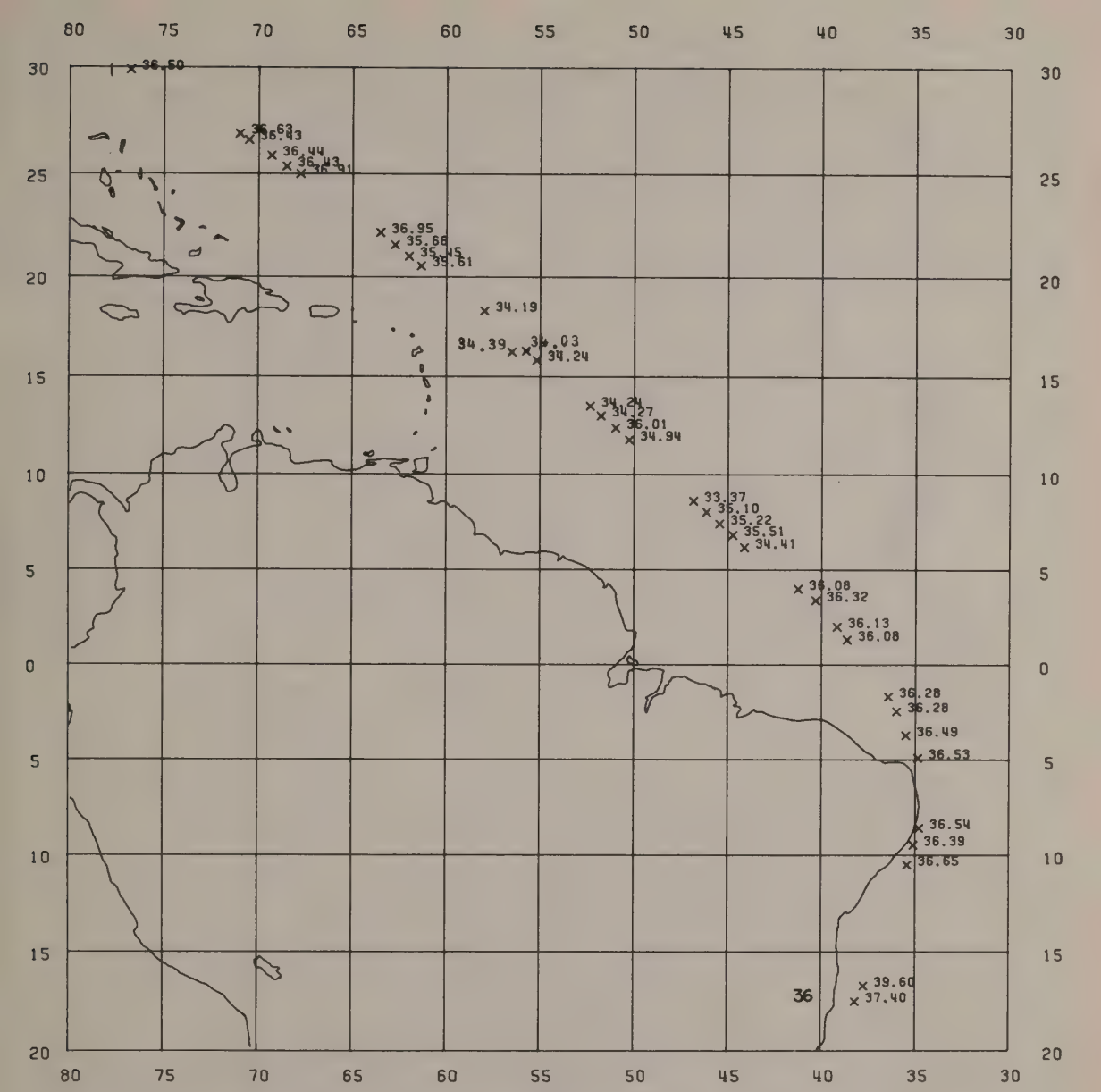


Figure 72.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Mormac Pride,* **4-13 October 1972.**

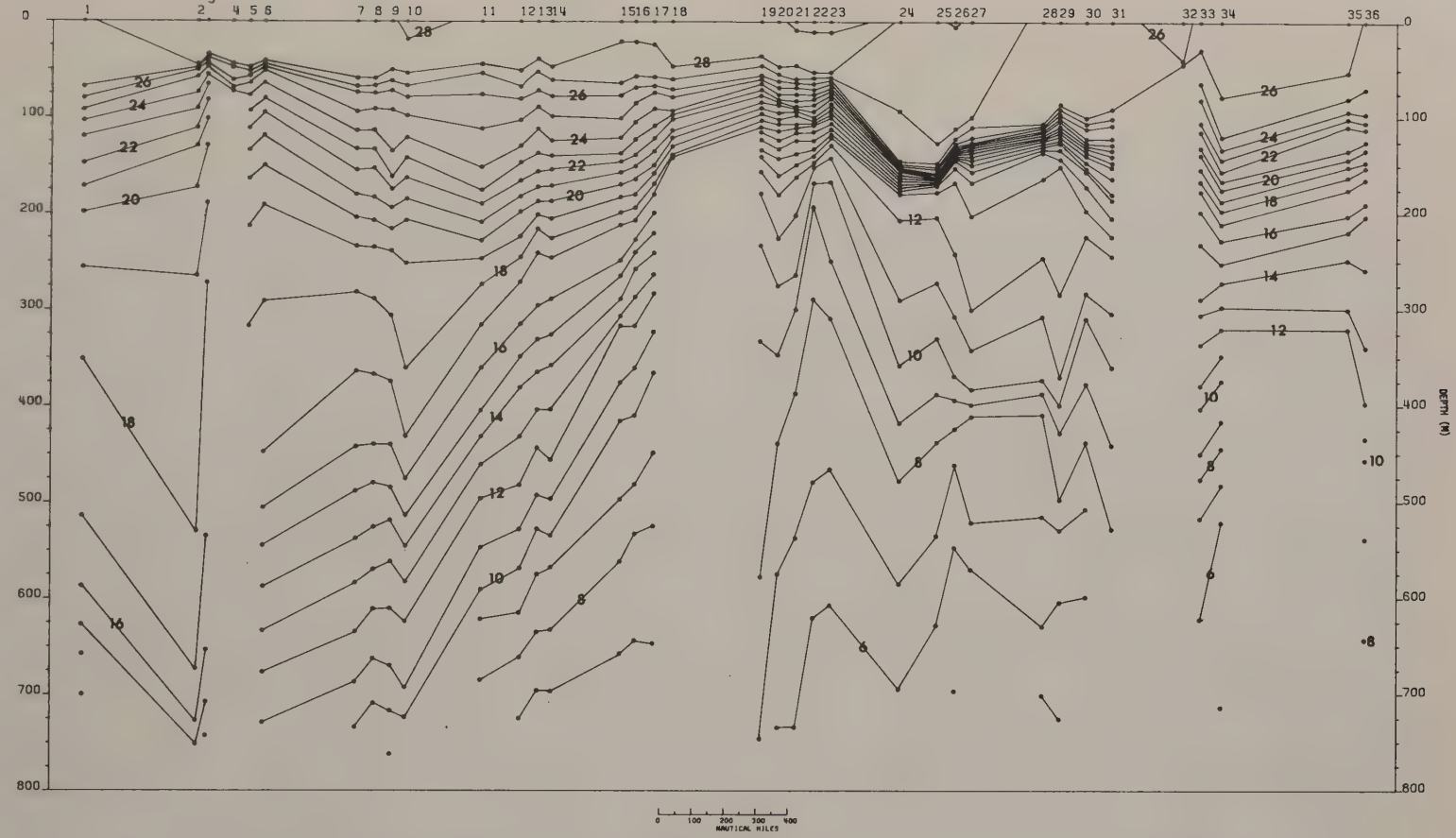


Figure 73.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Mormac Pride*, **4-13 October 1972.**

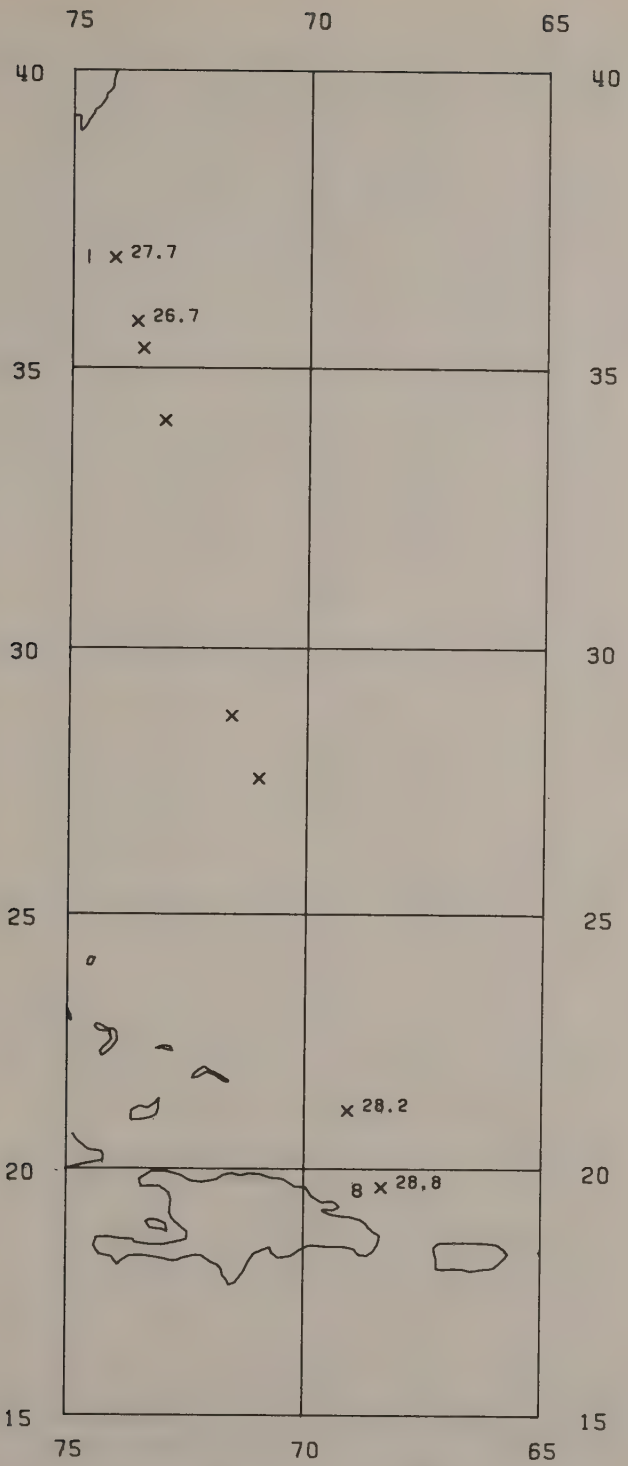
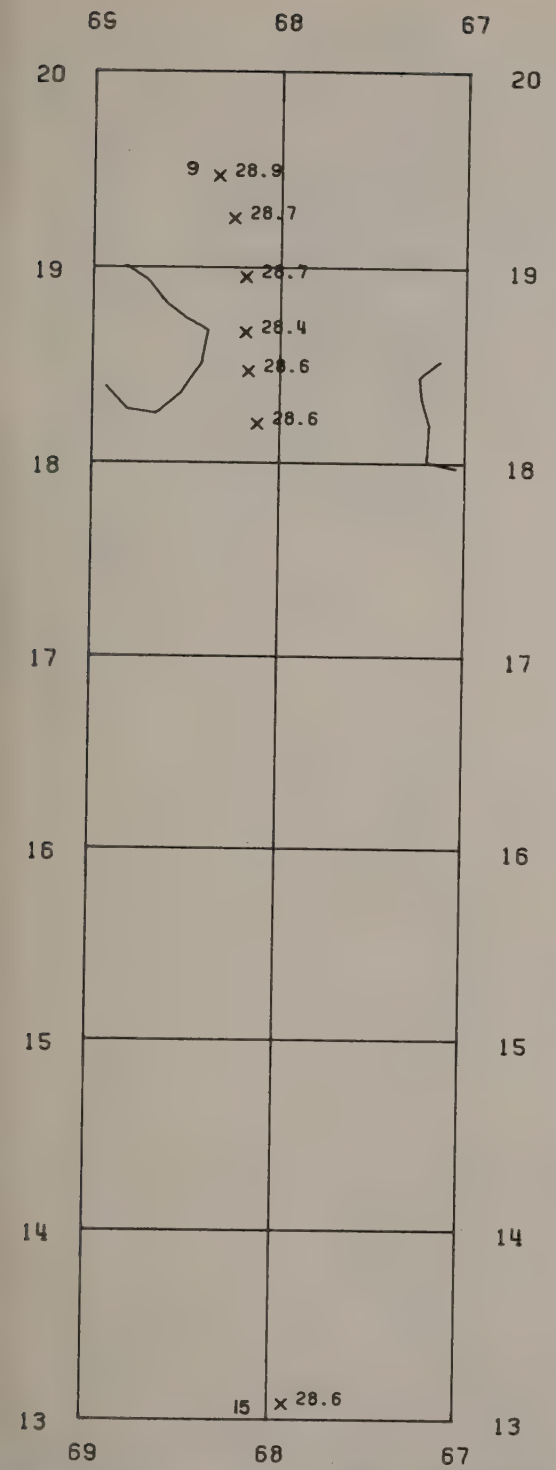


Figure 74.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz,* **15-18 October 1972.**

Figure 75.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, **15-18 October 1972.**



gure 76.—Sea surface temperature (°C) along the cruise track with he first and last stations numbered. *Santa Cruz*, 15-18 October 1972.

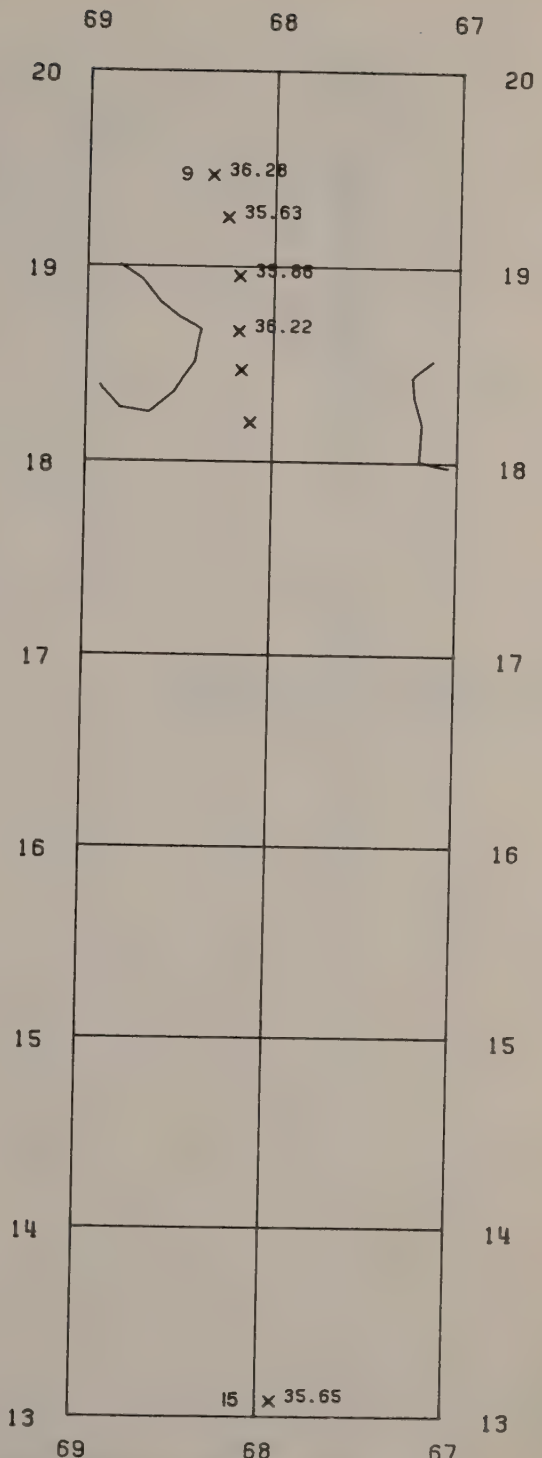


Figure 77.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, 15-18 October 1972.

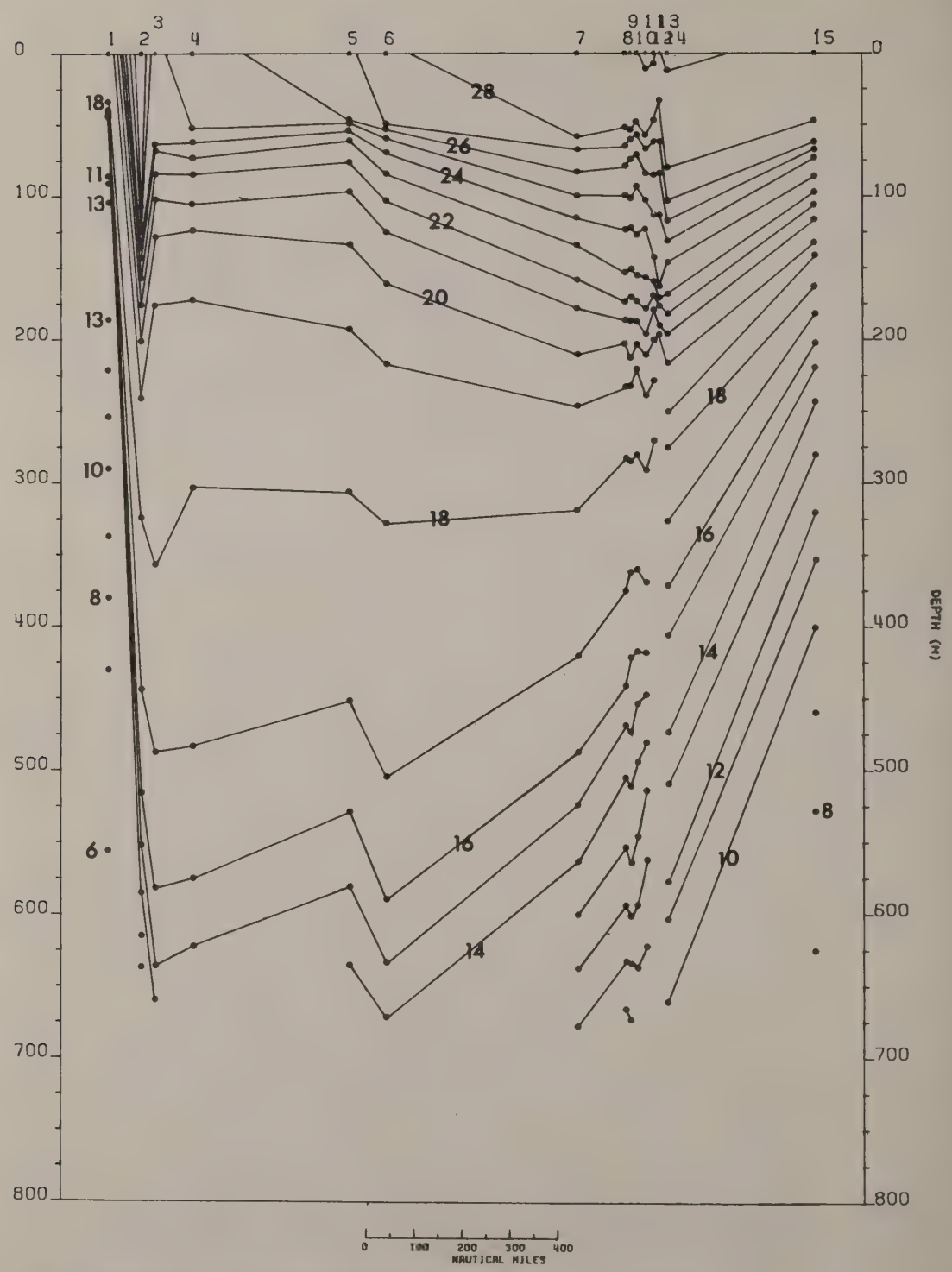


Figure 78.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz,* **15-18 October 1972.**

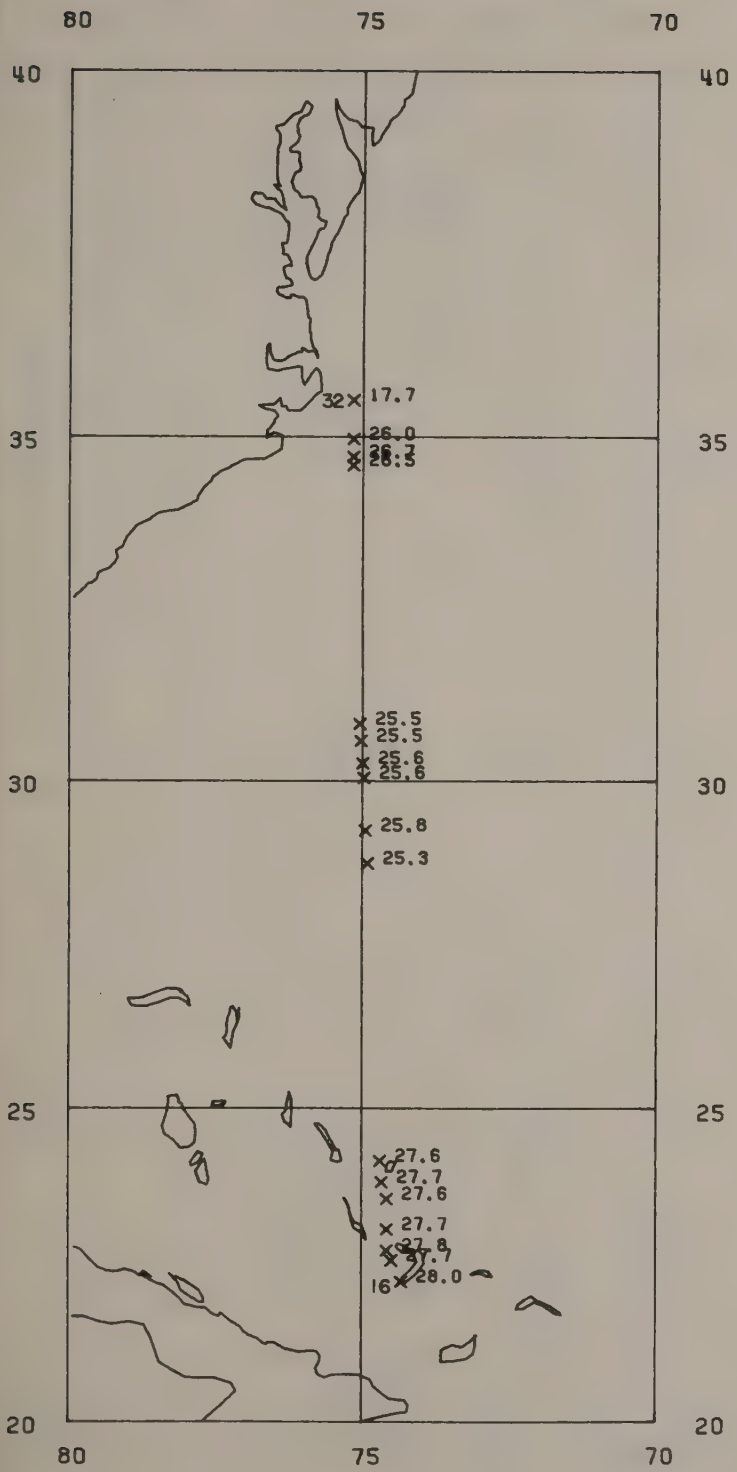


Figure 79.—Sea surface temperature (°C) along the cruise track with the first and last stations numbered. *Santa Cruz*, **3-5 November 1972.**

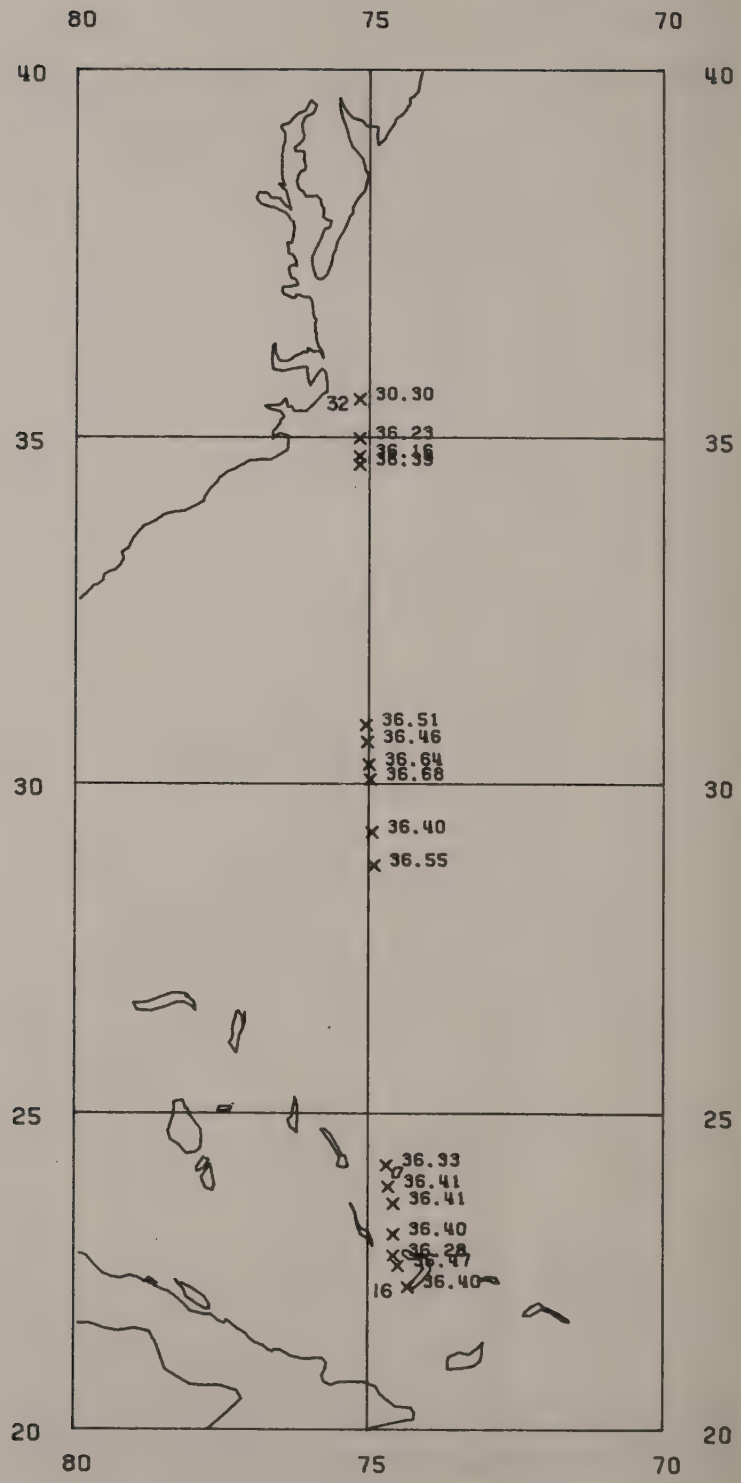


Figure 80.—Sea surface salinities (‰) along the cruise track with the first and last stations numbered. *Santa Cruz*, **3-5 November 1972.**

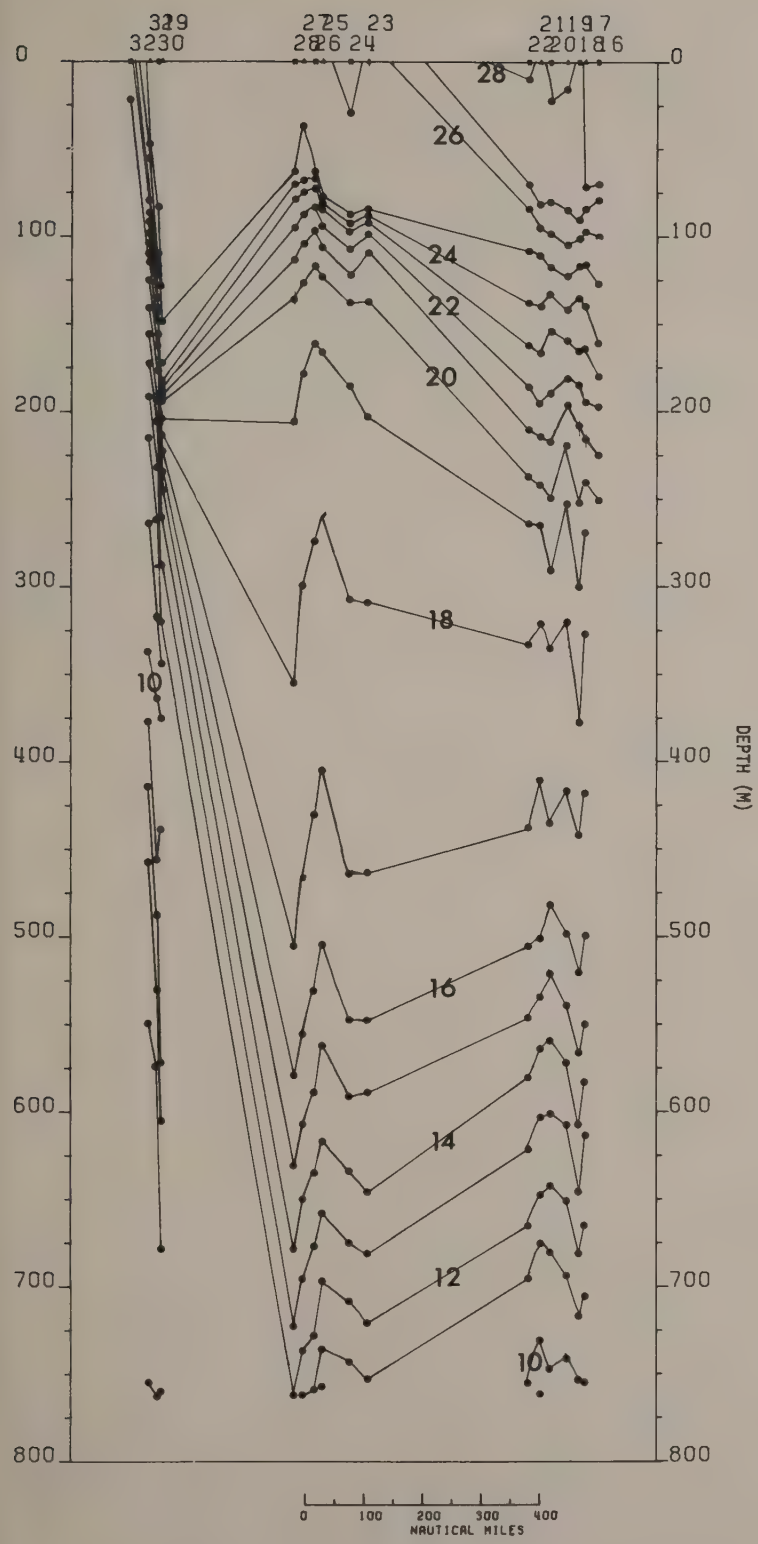


Figure 81.—Vertical distribution of temperature (°C) in the upper 750 m. Contour interval 1°C. *Santa Cruz*, **3-5 November 1972.**

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